# CURRENT SCIENCE

Vol. XV] FEBRUARY 1946 [No. 2

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## OVERSEAS TRAINING OF TECHNICAL PERSONNEL

EARLY in October 1944, Sir Ardeshir Dalal, the then Member in Charge of the Department of Planning and Development, sponsored a scheme for sending students abroad for advanced studies in the United Kingdom and the United States of America: the scheme was intended to increase the supply of competent technical personnel needed in connection with the realisation of the plans for post-war development. The selection of the first batch of students has been completed; according to the report of the Overseas Scholarship Selection Board, recently published by the Government of India, 8,835 applications were considered and 354 candidates were finally selected after interviewing 444 applicants. These figures do not include the scholars interviewed and selected by the Provincial Governments and the Indian States. The total figure, however, exceeds 700. While a good proportion of them have already reached their destination, a considerable number of students are still to embark on account of lack of passage and on account of the uncertainty of admission into the American and British Universities and Research Institutes. In the meanwhile, the Central Government have invited applications for the award of foreign scholarships in 1946-47; the brochure which has been issued for the information of the applicants declares that "arrangements for instruction will be made primarily in the United Kingdom and the U.S.A. but, provided that satisfactory arrangements can be made, in other countries also, such as Australia, Canada and New Zealand".

It will be admitted that the "arrangements for instruction" made for the benefit of the preceding batch have not been as satisfactory as one would wish. Reports of dissatisfaction at the standard of facilities and opportunities for study offered by some of the centres of learning, have reached this country. It is particularly painful that such reports should have come from students who have chosen to study in the United Kingdom. Students who have been deputed to England represent some of the best judged by the highest standards of academic distinction and intellectual attainment; some of them have had training in research and have shown special aptitude for a career of scientific research. It would be tragic if such students should be denied the best opportunities for training which British Universities and Research Institutes could offer.

Professor A. V. Hill, in his report on Scientific Research in India, had already warned that the British Universities, during the post-war period, would become crowded; the British had to face their own problems of Scientific and Technological Education and Reconstruction. Six years of the terrible war, punctuated with anxious months of blitzing, had created a distressing deficit in the supply of scientific personnel. The resources of their

foremost Universities and Institutes will naturally be mobilised to make up this deficit. The paralysation of the German centres of Science and Technology which used to attract a large number of European and Indian students, imposes a further strain on the British Universities.

American Universities have to meet similar responsibilities, although their problems are not so acute nor so distressing. Dr. Vannevar Bush, in his report to the President, *Science, the Endless Frontier*, points out that "the deficit of science and technology students, who, but for the war, would have received bachelor's degrees in these fields will amount in 1955 to about 17,000, for it takes six years from college entry to achieve a doctor's degree of its equivalent in science or engineering". But the resources of the American Universities and Research Institutes are immense and they are, therefore, in a position not only to solve their problems of deficit in scientific talent but to welcome foreign scholars for training. Thanks to a variety of factors and a complexity of circumstances, particularly the exodus of the eminent men of science and technology from Europe and the lavish Governmental support extended to the wartime research, the American Universities and Research Institutes have attained a position of unchallenged pre-eminence. A good proportion of our scholars for some years to come will no doubt choose to draw inspiration from the American centres of learning.

In view of the difficulty for admission to the first rank centres of learning in the United Kingdom and America, the Government of India are trying to make arrangements in other countries like Australia, Canada and New Zealand. This is very good more so far as it goes. There are, however, other countries beyond the orbit of the British Commonwealth, which might be seriously and advantageously thought of, we mean particularly Russia, Sweden and Denmark. These countries have made great headway in certain fields of science and technology, and in certain branches, they represent the only centres in the world where proper and adequate instruction can be had. Difficulties due to language, which might perhaps be raised in the case of Russia, need not be considered very serious since Indian students, unlike the English, have a genius for mastering languages; have not scores of Indians gone to German Universities for training? So long as we must, we should help our young men to seek admission into the foremost seats of learning in the world, irrespective of political barriers and nationalities. We earnestly hope that the Central Government will seriously take into consideration the advisability of exploring the great and fruitful possibility of deputing a good proportion of our scholars to Russia and the Scandinavian countries.

## PALUDRINE (M. 4888)—A NEW DRUG IN MALARIA*

RESULTS of experiments with Paludrine have been announced as the most potent anti-malarial drug known. The drug has been thoroughly tested in 200 cases of malaria amongst Australian soldiers, who volunteered as patients at a medical research unit at Cairns, North Queensland. Brigadier N. Hamilton Fairley was in charge of the experiments, assisted by a large team of research workers, including physicians, pathologists and entomologists.

It has been claimed that this new drug is much more effective than either quinine or atebrin. Paludrine produces radical or permanent cure in the dangerous malignant type of malaria. The percentage of cure in the benign tertian malaria is not yet known and it is too early to assess its value in this type of infection; but the results of observation at Cairns suggest that one or two tablets (each 0·1 gm.) taken each week end would give complete freedom from attack and would probably control relapses indefinitely until cure was attained.

In malignant malaria paludrine has been found to destroy the parasites inoculated by the infected mosquitoes at an early stage of their development. In consequence the parasite never gains access to the blood circulation. if three tablets of paludrine are taken three hours before the volunteer is bitten by heavily infected mosquitoes, malignant tertian malaria does not occur. This definitely proves that paludrine is a true phophylactic. Similarly, if volunteers taking one tablet daily, be bitten by mosquitoes infected with benign tertian malaria, they fail to develop symptoms of malaria or to show any malarial parasites in the blood while paludrine is being taken.

A remarkable feature of this drug is the smallness of the dose required to control an attack of malaria—0·1 gm. only has proved sufficient to end an attack and bring temperature to normal in both benign tertian and malignant tertian types of malaria. Nothing like this can be achieved by either quinine or atebrin.

The potentialities of this new drug has not yet been thoroughly explored, but from the recent reports there is every reason to believe that an important new discovery has been made, which will open up a new vista in the chemotherapy of malaria.

N. N. De.

* Abstracted from Release No. P. 255 of Public Relation Officer, Australian High Commissioner's Office, 7, Metcalfe Road, Delhi.

# THE ELECTRONIC THEORY OF VALENCY*

THE remark of Sir J. J. Thomson while opening a discussion on the subject at the Faraday Society in 1923, "The electron dominates the field of chemistry", is true even now, though our approach to the problems are somewhat different to-day. A satisfactory theory has to take into account not only the possible stable molecular forms but also the means of attaining the requisite configuration while ordinarily valence theory takes note of only the former.

The electronic theory of valency begins with the publications of Lewis and of Kossel and using a static model of the atom Lewis was able to explain a whole lot of chemical facts. By the time these were reconciled with the dynamic model of Rutherford and Bohr with Lewis's postulate, "an orbit as a whole, and not the electron in some one position within the orbit, is the building stone of atomic and molecular structure" one had to reckon with the upheaval caused by the new quantum theory. Chemists have been accustomed to classify bonds into various types: ionic, homopolar, semipolar and metallic, in the interpretation of each of which the quantum theory has been used. The present report deals with this new development. These classifications can be regarded at best as a useful guiding principle, the concept of valency itself being essentially vague. The concept and the classification can best be regarded as a convenient simple picture of the fundamental energy relationships on which molecular architecture is based.

In tackling the problem of molecule building with known atomic structural units, the principal difficulty facing the investigator has been mathematical and approximations were, therefore, inevitable. We have two different modes of approach: the method of molecular orbitals developed essentially by Lennard Jones, Hund and Mulliken and the method of localised electron-pairs or the H-L-S-P method. Lewis's concept of the ionic bond is essentially valid even now while the interpretation of the metallic bond is a triumph of the new quantum theory but the covalent or homopolar bond is the one that has brought out the limitations of either method of approach.

When atoms are brought together, the interatomic interactions may be expected to appreciably modify the atomic wave functions but as a first approximation, one can treat these as remaining unchanged. This assumption is implicit in both the methods. The energy of a molecule can be expressed as a sum of Coulomb integrals involving atomic wave functions and exchange integrals involving electrostatic interactions of electrons and nuclei. In choosing the atomic wave functions, the ground state is not the only one to be considered. For instance, in the formation of hydrogen from the atoms, kinetic studies have shown that the formation of the molecule involves a three body collision in which the third body takes away the excess energy liberated in the reaction. In interpreting the interaction one has to visualise a non-classical effect whereby a strong attraction is followed by a repulsion, an equilibrium corresponding to molecule formation being obtained. For a stable bond between the atoms, the two electrons taking part must combine so that the resultant spin becomes zero, the bond energy being the sum of the two types mentioned earlier. The initial success of the Heitler-London method with hydrogen led to a rapid though incomplete development of the theory to the interaction of atoms with several electrons with more than one unpaired. In these applications, one has often to consider excited states of the atom in addition to the ground state. Combining these ideas with a consideration of electron density distribution in space, Pauling and Slater have devised a theory of directed valence forces consistent with the known stereo-chemistry of carbon compounds.

A normal carbon atom has the arrangement of electrons $1s^2$, $2s^2$, $2p^2$ and the normal state is $^3P_0$ with the slightly higher $^1S$ and $^1D$. Assuming the wave functions of an electron to be separable and factorised into radial and orientational factors, the $2p$ electrons must differ in their orientational part. With two such unpaired electrons, two stable bond pairs can be formed. Four bonds can, however, be formed by the excited $^5S$ state of carbon with the configuration $1s^2$, $2s^1$, $2p^3$. In all cases where bond energy exceeds a value of 1·6 volts (the difference between the two states of carbon), one can reasonably assume the participation of this state and most organic compounds happen to belong to this category. Using the $^3P$ and $^1D$ states it is possible to construct a divalent carbon atom, but a tetravalent carbon atom requires four electrons, each independent and in a singly occupied orbit. An $sp^3$ configuration enables the construction of four independent orbits. Three mutually perpendicular $p$ electrons and a spherically distributed $s$ electron with the mutual repulsive forces of the hydrogen nuclei can lead to a tetrahedral form for the methane molecule, but this would imply one carbon-hydrogen bond different from others, which is contrary to known experimental evidence. Now any suitable wave function must satisfy the conditions that the orbits must be mutually orthological and have the aggregate configuration $2s2p^3$. Pauling has shown that both these and the equivalence of the C-H bonds in methane, satisfied by using the concept of $sp$ hybridisation. *The use of hybrid bond orbital functions is an essentially empirical approach* that has been justified by its successful interpretation of phenomena in organic and inorganic chemistry. This hybridisation, by introducing the $2s$ wave functions in the compound orbital functions is considered possible only if the energy of the $2s$ state is not very different from that of the $2p$.

Mention should be made at this stage of a fundamental principle of quantum mechanics used in chemical applications and underlying

* Proceedings of a Symposium held on the subject at the Annual Meeting of the Indian Academy of Sciences, at Udaipur, Dec. 1945.

the concept of 'resonance'. Any structure representing a system corresponds to a wave function $\psi$ and the energy value calculated using the correct wave function $\psi_0$ is lower than that calculated using any other wave function $\psi$. If there are several structures that might conceivably represent the normal state of the system, a general function of the form

$$\psi = a\,\psi_1 + b\,\psi_{11} + c\,\psi_{111} + \cdots\cdots + n\,\psi_\infty$$

can be obtained. The best relative values of the coefficients are obtained by making the energy value a minimum. The structure of such a system is *not intermediate between the various forms* but the normal state is described as *involving all structures in resonance*. As a consequence of this, the system is stabilised by an amount of energy, 'the resonance energy'. There is a certain amount of arbitrariness in the concept of resonance but this is to some extent offset by the convenience and value in its chemical applications.

The concept of resonance is common to both methods of treating valence problems. In the HLSP method, the contribution of ionic terms corresponding to both the electrons being with the same nucleus is not given adequate emphasis and the expression for the total energy of a system does not take into account the effects due to the Pauli exclusion principle. In the method of molecular orbitals both these are taken note of with a possible overemphasis of ionic terms. The wave function expresses the motion of an electron in the resultant field from all the nuclei and the other electrons in the system. For a diatomic molecule the theory is essentially a discussion of the quantum numbers of electrons in an axially symmetrical field. Mulliken observed that extension to a polyatomic system resolves itself into a question of determining the behaviour of various atomic orbitals conforming to the symmetry of the system.

The position is analogous to conditions pertaining to the movement of an ion in the field of other ions. While it is difficult to say categorically whether the method of molecular orbitals or the HLSP method is the better approximation, the molecular orbital methods are more convenient for qualitative discussion but the HLSP method has been more often used for quantitative calculations.

Among the useful results obtained by Pauling's interpretation of the chemical bond, bond energy, bond length, bond order and partial ionic character of covalent bonds constitute a fundamental departure from earlier approaches to the subject. The method has been remarkably successful in the study of organic compounds but one has to guard against an overemphasis of the findings of such analysis. Both the electronegativity scale and bond energy relationships are essentially empirical. In deriving bond energy values, Pauling uses the postulate of the additivity of normal covalent bonds and where this fails, the postulate of the geometrc mean. Pauling himself remarks, "It is probable that in general, the postulate of the geometric mean leads to somewhat more satisfactory values than the postulate of additivity for normal covalent bonds between unlike atoms, ..... We shall find it *convenient* to make some use of the postulate of additivity as well as the postulate of the geometric mean" (*italics mine*). From single bond energy values determined by an analysis of thermochemical data complete electronegativity scale has been built up, and in a very large number of cases the values thus obtained are proportional to the sum of the first ionisation energy and the electron affinity of the atom. Where atoms are linked together by single bonds, the bond moments are found to be related to the difference in their electronegativities. There are, however, significant exceptions. On the basis of the electronegativity scale the carbon-iodine bond cannot have any significant amount of ionic character, and hence should have zero moment, but is found to have the same bond moment as other carbon-halogen bonds. The phosphorus-hydrogen bond is another instance where the correlation breaks down. With such exceptions, one has to view with some circumspection conclusions on the partial covalent character of bonds in ionic crystals, unless some more unequivocal evidence is forthcoming.

The correlation of bond distance and bond order is on a somewhat better footing. If the potential function of the resonating bond be represented as the sum of two parabolic functions involving the single and double bond potential functions, an expression of the type

$$V(R) = \tfrac{1}{2}(1-x)\,k_1\,(R - R_1)^2 + \tfrac{1}{2}\,x\,k_2\,(R-R_2)^2$$

is obtained. The derivative of this with respect to $R$ equated to zero for the equilibrium order and the force constants. If $k_2/k_1$ is taken as 3, one gets

$$R = R_1 - (R_1 - R_2)\,\frac{3x}{2x+1}.$$

The curve corresponding to this equation agrees very well with the experimental values for carbon-carbon bonds and with a change of scale for other bonds as well. The force constant ratio, however, is more than that of any known instance and Pauling attributes this discrepancy to the neglect of resonance energy in the assumed potential function. Using the observed constancy in the carbon-carbon single-bond distance in the saturated hydrocarbons and in diamond, this concept of bond order has enabled the interpretation of conjugated systems and the phenomenon of hyperconjugation.

The concept of resonance has also been used in the interpretation of the aromatic compounds and their reactivity together with a plausible explanation for the existence and stability of free radicals. Another important application of these concepts is provided by structures involving hydrogen bonds without the necessity of postulating a covalency of two for hydrogen.

An important extension of the same principles of hybrid bond orbital functions is in the interpretation of the complex compounds of the transition elements. Notable examples are provided by the metal carbonyls, and the cyanide complexes in which the metal carbon bonds are much shorter than could be accounted for with a single bond while the carbon-oxygen and carbon-nitrogen bonds turn out to be longer than required by a triple bond.

Mention should be made here of the different significance to be attached to the term 'co-ordination'. The classical chemical concept couples this with the donor-acceptor properties of atoms or ions. In the interpretation of ionic crystals and in the metal complexes we notice a different meaning. As with other bonds, co-ordination also involves both co-valent and ionic types.

A logical extension of the resonance concept is the interpretation of the transition-complex in a chemical transformation as a system in which the extreme degenerate structures are the reactants and the products. Polanyi and co-workers have been able to successfully interpret the substitution reactions of alkyl halides on this concept and one may naturally expect more developments on these lines.

In the discussion that followed, Sir C. V. Raman drew attention to the observations of Mr. G. N. Ramachandran on the fluorescence spectrum of the diamond which appeared to go against the whole concept of hybridisation as interpretation of the results was possible by assuming the existence of carbon atoms in the ground state alone in the diamond molecule. Against this it was pointed out that the mass of chemical facts that required the concept for a proper interpretation and the possibility of the selection rules having to be different with hybrid bonds could account for any apparent discrepancy.

Dr. Nagendra Nath gave an ingenious picture of bond formation between carbon atoms (*single bonds only*) without any hybridisation involving the 2*s* electrons of one atom and the 2*p* electrons of the other by an extension of the Hietler-London treatment of hydrogen molecule. In order to satisfy the requirements of spin, it was assumed that the paired electrons got unpaired before bond formation. Using this picture he was able to account for the four forms of diamond. In the course of the discussion, Dr. Nagendra Nath said that no attempt has been made by him to interpret multiple bonds nor the case of bonds between different atoms. Even with regard to the particular bond in question one has to await fuller details before accepting or rejecting the interpretation.

Dr. G. V. L. N. Murti gave a brief account of the application of Raman spectra to interpret hydrogen bonding. Prof. K. S. Krishnan, the Chairman of the Symposium, Prof. Bhagavantam and others took part in the lively discussion that followed.

S. V. ANANTHAKRISHNAN.

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## CHEMISTRY AND PHARMACY*

IN the course of his Presidential Address to the Sixth Session of the All-India Pharmaceutical Conference held in Bangalore during the first week of January 1946, Sir S. S. Bhatnagar said :—

"A nation that merely follows the example of other nations, howsoever great it may become, can never lead. Industry will really flourish only in those countries which are able to produce quality goods of an original character. We should, therefore, cease to quarrel over trivial issues such as the relative importance of pure and applied sciences and get to brass tacks, particularly as there is no line of demarcation between the two so far as your own science is concerned. Not long ago, chemistry was entirely pharmacy and pharmaceutical chemistry, and all chemists of any note were really pharmaceutical chemists. The interesting fact is that in your domain, it was the applied science that gave birth to the science of pure chemistry. With the rapid growth of pure science, the relative importance of the two may have changed. Nevertheless, the fact remains that pure chemistry is a child of pharmaceutical chemistry and howsoever much the pure chemist may look down upon a pharmacist or a pharmaceutical chemist, he has to admit that pharmaceutical chemistry provided him with excellent ancestry. The most recent achievements of the chemist which have resulted in the development of such medicinal substances as penicillin, D.D.T., streptomycin, gammexane and several new sulpha drugs seem to show that pharmaceutical chemistry experienced a specially virulent growth during the fateful years of this war. Nobody connected with researches on these important subjects can be branded as a mere druggist and assigned to a lower order of scientific achievement. However, in order to raise your status in international science, the pharmaceutical chemists and the pharmacologists and the medical men amongst you, must concentrate on high class research work. That India has the necessary talent to make contributions of great importance in these subjects can be gathered from the fact that several outstanding discoveries have been made in the past in this country. For example, after the brilliant discovery of Chistina and Caronia that tartar emetic was useful in the treatment of infantile kala-azar of the Mediterranean basin, Rogers in India introduced the use of tartar emetic intravenous for the treatment of Indian kala-azar. Soon after this, Sir U. N. Brahmachari introduced the use of sodium antimonyl tartarate for the treatment of the disease; subsequently his name as the discoverer of urea stibamine, a cure for kala-azar, became well known far and wide, as this drug above all others has helped greatly in the conquest of kala-azar in India. The drug industry which followed in the wake of Sir U. N. Brahmachari's discovery, is India's very own and will long remain hers as both the discovery of the cure and manufacture of urea stibamine were results of indigenous talent. Mention must also be made here of researches carried out by

* Extracts from Sir S. S. Bhatnagar's Presidential Address to the Sixth All-India Pharmaceutical Conference, Bangalore,

Col. Sir Ram Nath Chopra and his colleagues which have helped the industry and pharmaceutical research.

"The scope for a really great pharmaceutical industry in this country is, however, intimately connected with research work in chemistry, in physics, in biology, in nutrition, in pharmacology and in clinical medicine. I claim to be no prophet but I feel that a pharmaceutical industry is bound to follow in the wake of the proposed basic chemical industry in this country. We can, however, hold our own against the competition which is sure to follow only if we have new drugs, new processes, new methods of cure and brilliant research work to our credit which we may claim as our own. This is the new outlook which is engaging the attention of U.K., U.S.A. and U.S.S.R. to-day. The greatest asset to a nation is not gold, but an original mind. We have not the gold, and although it does not necessarily follow from this that we have an excess of original mindedness in this country, I hope I am right if I make bold to say that the original mind is not such a rarity in India as gold, although both may require to be dug out.

"The pharmacist who does not believe in research is lowering the status of his profession. On the other hand, the pharmacist who conducts research or is research-minded establishes those contacts with research workers in pure science and medicine which entitles him to respect amongst scientific workers. To-day the science of pharmacy must look to all sciences for the increase and expansion of its scope, as the instruments and materials which help in the eradication of disease are spread over many fields of study. Whilst organic chemistry is still, and will long continue to be, the fundamental branch of chmistry which the pharmacist and the pharmaceutical chemist must know, colloids, inorganic substances, radiations and tracer elements are being increasingly employed by medical men, and the future pharmacists will have to be proficient not only in organic chemistry, but also in nuclear physics, nuclear chemistry and in medicine and biology.

"The trend of research in the fields connected with your Association's activities in international science shows that subjects which have attracted the greatest attention are (1) Chemotherapy, (2) Antibiotics, (3) Hormones and Vitamins and (4) the rapidly developing subject of Biophysics.

### Chemotherapy and Antibiotics

"In the field of chemotherapy, after the classical work of Ehrlich and the synthesis of such drugs as salvarsan, the discovery of atebrin, plasmoquin and germanin were epoch-making, but they were completely eclipsed by the revolutionary synthesis of prontosil by Mietzsch and Klarer and the demonstration of its therapeutic properties by Domagk in 1937. Following upon this discovery, no less than 5,000 new sulphur compounds have been synthesized and examined, and from this colossal effort in the world's laboratories at least five compounds of supreme importance have emerged—sulphaacetamide, sulphadiazine, sulphaguanidine, sulphapyridine and sulphathiazole, which have become *official* in the British Pharmacopæia. The production of sulpha drugs reached a peak in 1943 when in U.S.A. alone, above ten million pounds were produced.

"In 1941 with the discovery of penicillin by Fleming and Florey, the interest has shifted to compounds produced by the micro-organisms themselves. Compounds such as patulin, vivicillin, gliotoxin and helvolic acid have been discovered, some of these poorer than penicillin in antibiotic properties, others very much better though more toxic to the human organism. This vast field is, however, just beginning to be explored and its full potentialities are yet unknown.

"After the structure of these compounds becomes known, a new field for the synthetic organic chemist will be opened up and it will be no wonder, just as the simple synthetic methyl-naphthaquinone proved to be more active than the naturally occurring vitamins $K_1$ and $K_2$, a simpler synthetic compound may be discovered far more active in antibiotic properties and less toxic or less readily excreted, than penicillin or any of the natural compounds.

### Vitamins

"In the fascinating field of vitamins the most significant advance has been made in the discovery of the factors within the fold of the $B_2$ complex. Factors such as pyridoxin, pantothenic acid, biotin and folic acid have been isolated in a pure form and are being made on a large scale. Of these, folic acid seems to be most interesting and appears to be identical with the grass juice factor of Elvehjem. Even such simple compounds as choline, inositol, p-amino benzoic acid have been found to possess the properties of vitamins. New vitamins continue to be discovered such as $B_{10}$ and $B_{11}$ from the Wisconsin Laboratories. Substances known as antivitamins have been recognised and a maze of inter-relationships of the different vitamins such as was recognised in the case of hormones has been brought to light. A still more signal achievement is the synthetic production by tons of the well-known vitamins such as thiamin, ribo-flavin, nicotinic acid and ascorbic acid, making them available to the common man in the form of multi-vitamin tablets at a cost of not above two pice per head per day, and making possible the large-scale fortification of white flour and other common foods on a nation-wide basis. Even in this field large potentialities remain unexplored. While the majority of nutritionists continue to think in terms of the fight against malnutrition and deficiency diseases widespread in all countries, those in the vanguard of this research have been trying to find out what happens in the exceedingly mild forms of deficiency. Wilder from the Mayo Clinic has reported that in the early stages of vitamin deficiency the subject becomes depressed, irritable, quarrelsome, unco-operative and fearful. Such nervous conditions were associated with hormone metabolism and now we know that even dietary factors play a part in the mental make-up of man. As such it touches every living man, woman or child and shows the possibilities that lie ahead in the applied field.

## THE AUTONOMIC NERVOUS SYSTEM AND THE HYPOTHALAMUS*

DURING recent years much research has been carried out on the autonomic nervous system and an account of the various influences that this system exerts upon the body and on the numerous functions of the hypothalamus so far as they are connected with this system, is very interesting. Prof. De, in his Presidential Address, deals only with a few of the more important functions which are under the control of the hypothalamus. He has traced the history of the development of the knowledge of the sympathetic nervous system as far back as 1727, when du Petit first suggested the autonomy of the sympathetic nervous system. Jacque Benigne Winslow introduced the term "sympathetic" and the term "vegetative nervous system" was first used in 1880 by Marie Bichat. There has been some difference of opinion regarding the interdependence of these two systems. Towards the end of the last and the beginning of the present century new light has been thrown by the work of Langley and his school and the work of Gaskell on the vegetative nervous system. Gaskell demonstrated the connection of the sympathetic peripheral mechanism with the central apparatus and with the nerve cells in the spinal cord and pons. The presence of synapses in the path of the fibres was first revealed by Langley. Every fibre of the sympathetic system forms one synapse with a nerve cell at some point in its course and this is the only break in the continuity of the fibre. Each fibre path is composed of two sections—the pre-ganglionic and the post-ganglionic. The name "autonomic nervous system" was given to this system by Langley who divided the whole system into tectal, bulbosacral, thoracio-lumbar and enteric. The tectal and the bulbosacral outflows were grouped by him as "parasympathetic" and thoracico-lumbar as "sympathetic". Langley noted the antagonism between the sympathetic and the parasympathetic systems. The sympathetic system is catabolic and the parasympathetic system is anabolic. A delicately balanced co-ordination of the sympathetic and the parasympathetic activities is required to maintain the uniformity of the conditions of the body.

Prof. De then proceeds to discuss the various theories of transmission of nerve impulse. With the progress of work along these lines, the question of transmission of nerve impulse and of the liberation of the chemical transmitter at synapses in the autonomic ganglia, and of the release of sympathin and acetylcholine at the neuromuscular and neuroglandular junctions, has attracted much attention in recent years. A purely electrical theory cannot explain all the data satisfactorily. The chemical theory like the electrical one has not received universal acceptance. Probably both the chemical and electrical factors are concerned with the transmission in the synapses and neuromuscular and neuroglandular junctions and further work will bring the two views into harmony.

Dealing with the autonomic nervous system, its centres in the brain stem and somatic response and the cortical control, Prof. De says that the evidence of control exercised by the cerebral cortex over the autonomic activities is fairly full and conclusive; nevertheless, some workers have doubted the accuracy of these conclusions. The weight of evidence, however, from the numerous experimental investigations and from clinical observations of various workers points to a localisation in the precentral cortex, more particularly in the areas 4 and 6 (Brodmann). Recently, much attention has been paid to the hypothalamic region of the brain and evidence has accumulated to show that it plays an important part in some of the vital reactions of the body. It is now generally agreed that in the hypothalamus and in the other parts of the upper brain stem, there exists a number of nuclei—supra-optic, paraventricular, infundibular and mamillary—which govern to a great extent the reactions of the autonomic nervous system. Karplus and Kreidl (1927) were the first workers to show that electrical stimulation of the hypothalamus produced excitation of the sympathetic nervous system. Evidence of the presence of the parasympathetic centre in the hypothalamus was given by Cushing (1932). Heslop (1938) also established that the anterior part of the hypothalamus is a parasympathetic and the posterior part a sympathetic centre. The importance of the hypothalamus in the regulation of body temperature is now unquestioned. From the experimental evidence, it is concluded that there are two distinct centres for the regulation of heat and cold. The centre for reactions to heat is situated in the anterior part of the hypothalamus. Lesions located in the medial part of the hypothalamus in the region of the infundibulum have no effect on either centre. On the clinical side evidence is accumulating that tumours in the neighbourhood of hypothalamus produce changes in the body temperature. Since the mechanism of heat production is activated by the posterior hypothalamus, it stands to reason that it is governed by the adrenergically (sympathetic) innervated structure coupled with the somatically controlled shivering reflex; on the other hand, the mechanism of heat loss is primarily governed by a cholinergic mechanism (parasympathetic). The function of maintaining body temperature is thus a highly integrated reaction involving both divisions of the autonomic system and also the important somatic reaction.

Finally, the author deals with the part the hypothalamus plays on the control of blood-sugar. Borbeck (1940) showed that in cats, lesions in the hypothalamus predisposed to insulin shock and to serve hypoglycæmia. From this and various other facts it is reasonable to infer that the spinal sympathetic nuclei may be capable of maintaining the blood-sugar level to some extent when their connections with the higher centre is severed. De investigated the role of general anæsthetics on the blood-sugar level on the spinal sympathetic nuclei when these nuclei are separated from higher centres. He could not find any signifi-

* Summary of Presidential Address delivered by Dr. P. De, before the Section of Physiology, Indian Science Congress, Bangalore, 1946.

cant part being played by these nuclei in the production of hypoglycæmia. The numerous facts and observations of Bard (1928) and Foulton (1929) and Ingrahm (1929) led De to believe that all the general anæsthetics release the sympathetic hypothalamic centre from the cortical control. The poorer the cortical depression, the less the hypoglycæmia, and with the deepening of anæsthesia, as more and more of the cortical control was withdrawn, the greater and greater was the rise of blood-sugar.

From the foregoing statements, it is clear that the hypothalamus plays a very important part in the body and controls a large number of body reactions. The results of observations on this subject, especially their association with the automatic nervous system, though quite extensive, are still very incomplete and await further work.

N. N. De.

## THE INSIDIOUS TYPE OF LEAD POISONING*

IN his Presidential Address, Dr. Bagchi has presented some of the important features of his investigations on lead poisoning and its bearing on the post-war industrial reconstruction. By the term lead poisoning or plumbism is meant that one has imbibed lead in quantities larger than what is normally ingested with food and drink or inhaled with air or otherwise absorbed, and has been adversely affected or intoxicated by it. Lead poisoning, like all other kinds of poisoning, may be acute or chronic. Dr. Bagchi has discussed only the chronic form of lead poisoning, which is mostly of occupational or industrial origin and to a less extent accidental. He then goes on to describe the toxicity of lead and lead compounds. Lead, in whatever form it is introduced in the system, acts as a poison. Even metallic lead is a potent poison—the toxicity depending on the extent of its surface exposed to the tissues. The route by which lead is introduced into the system is also a determining factor in the causation of the toxic symptoms. It has been proved that lead is absorbed in larger quantity and much more quickly through the lungs than through the alimentary tract or the skin and that lead introduced into the system by inhalation is about 100 times more toxic than when it is swallowed. Discussing the insidious type of lead poisoning—its pathology and symptomatology—the speaker says that the classical type of lead poisoning or plumbism in which all the characteristic signs and symptoms described in the text-books develop, offers no difficulty in diagnosis. But quite a large number of people who happen to absorb only very small amounts of lead over a long time either from drinking water, cooking utensils, vermillion or similar other sources do not develop any of these symptoms and yet are known to suffer from plumbism. These cases have lately attracted the attention of the workers in this line and have been proved by chemical and therapeutic tests to belong to the insidious types of lead poisoning, which had hitherto escaped the notice of the clinicians.

There are many difficulties that stand in the way of diagnosing cases of lead poisoning. In the diagnosis of plumbism, the history of exposure to lead is a very important factor. This guides the physicians in the right direction and the laboratory findings confirm his suspicion, while clinical features help him to clinch to his diagnosis. The laboratory tests include examination of urine and fæces by modern methods of chemical analysis and chemical examination of tissues, *e.g.*, liver, kidney, heart, lungs, intestine, spleen, cartilage, skin, brain and bone. Hair has been found to be a suitable material for the detection of abnormal lead absorption in the system. The chemical examination of blood does not help in any way in cases of insidious type of poisoning; in chronic cases, even with well-developed symptoms, the blood lead does not usually exceed the normal limits. Amongst other signs and symptoms may be mentioned blue line in the gums, and punctate basophilia, but unfortunately, both these are most unreliable and even when present they do not indicate lead intoxication but only lead absorption. Wrist drop, arteriosclerosis, and vascular spasms may be found only among those who absorb lead in heavy doses; rarely these are to be expected in insidious types.

Before concluding Dr. Bagchi laid stress on the importance of lead poisoning, particularly of the insidious type and its implication. As it is mostly of industrial origin and as rapid industrialisation is expected early, he puts it forward as a plea for reorientation of the system of Public Health Administration and Medical Education in this country. Dr. Bagchi impressed on the importance and development of Industrial Hygiene and felt that the establishment of a Central Research Institute for Industrial Hygiene, creation of an Industrial Health Research Board and raising the standard of teaching in Medical and Public Health Sciences will be helpful in bringing about the solution of new problems of health and disease arising from the industrialisation of the country and thus to protect and improve the health of the workers.

N. N. De.

* Abstract of Presidential Address to the Section of Medical and Veterinary Science, delivered by Rai Bahadur K. N. Bagchi, before the 33rd Session of the Indian Science Congress, Bangalore, 1946.

## DEVELOPMENT OF KIDNEY IN FISHES*

WHILE the kidney in all vertebrates is, more or less, derived from the same embryological source, the precise mode of its development varies in different classes of vertebrates. The first developed part of the kidney which is functional in the larval life of frogs, bony fishes and some other fishes is very rudimentary amongst sharks. The larval kidney serves the larva for some time. But as development proceeds, the succeeding portions of kidney develop and this development takes place in two stages. The first stage represents the whole kidney in all fishes except sharks where the hinder elements alone function in the adult and in this respect the sharks resemble the

* Abstract of Dr. Moghe's Presidential Address to the Section of Zoology and Entomology, Indian Science Congress, Bangalore, 1946.

higher vertebrates. Dr. Moghe dealt with the development of kidney in all groups of fishes such as the sharks and fishes, ganoids and bony fishes. In the last group his own investigations point to a different mode of development from the commonly accepted one found in the text-books. The accounts in text-books are based on the investigations of Felix published in 1896 and 1902 and these place the bony fishes in a separate class from other fishes and vertebrates. Dr. Moghe, however, considers that the development of kidney in the bony fishes is of the same order as in other vertebrates. Another controversy emphasised by Dr. Moghe relates to the larval kidney of most fishes. Is the kidney duct formed first or the kidney tubule? In the opinion of some workers the duct is formed first and the anterior end of the duct differentiates to form the kidney tubule; others consider that the kidney tubule is formed first and its terminal end opens into the duct which is independently formed.

B. S. B.

# OBITUARY

## THE LATE MR. KAPILRAM H. VAKIL

**M.Sc. (Tech.), F.R.I.C., A.M.I.Chem.E.**

ON the 28th of January 1946, the death occurred at Mithapur, of Mr. Kapilram H. Vakil, and with his passing away from our midst, scientific and industrial India lost one of her most eminent sons. Mr. Vakil was a self-made man. After graduating from the Elphinstone College, Bombay, he proceeded to England for further studies in technological subjects and very soon obtained the M.Sc. (Tech.) degree of the Manchester University as also several other diplomæ in applied chemistry. Mr. Vakil was very early recognised as an expert in oil and soap technology and was immediately absorbed by the Tatas. His passion and desire to expand his knowledge to the benefit of the country soon found Mr. Vakil conducting work on problems relating to salt and alkali industries. He was mainly instrumental in setting up the huge alkali factory in Dharangadhara State as also the Tata Chemicals plant at Mithapur, the latter being the largest unit in India producing marine chemicals. To keep himself abreast of the terrific strides made in America and Europe, he visited these continents over a dozen times and personally visited important works to get himself acquainted with the latest developments in processes as also in machine design.

On numerous occasions, Mr. Kapilram Vakil was approached both by Government and non-official bodies to preside at or to be a member of several committees. Important among these may be mentioned the Subjects Committee of the Indian National Congress, the Indian Merchants' Chamber, the Technical Education Committee (Government of Bombay), the Heavy Chemicals Committee (C.S.I.R.), the Electro-Chemicals Committee (C.S.I.R.), the Heavy Chemicals Panel (P. & D. Department of the Government of India), the Bombay Provincial Industries Chemical Sub-Committee and the Provincial Industrial Research Committee. Mr. Vakil was a member of the Advisory Board which was set up to guide the recent Fertiliser Mission. He was also a member of the Advisory Board of the Royal Institute of Science, Bombay, and the Council of the Indian Institute of Science, Bangalore. Mr. Vakil's diverse interests will become evident when it is mentioned that he took an important part in the framing of the Santa Cruz (East) Town Planning Scheme.

As the author of several important papers and books on technical subjects, Mr. Vakil's name was a by-word with scientists and industrialists alike. Several of his industrial processes are patented and are in use even now in India as well as abroad.

His devotion to science was to the very extreme and he dedicated all his time, nay his very life, to the cause of the scientific and industrial development of his country. It will be very difficult to fill the void created by his sad demise. May his soul rest in peace and may we be given the sense of duty to keep on burning the torch of enlightenment which he has lit!

MATA PRASAD.

## PROF. JOHAN IVAR LIRO

HOSTILITIES having been ended, news have begun to trickle down from Europe about the happenings during the past six years. Sad news has reached us that Prof. Johan Ivar Liro has been lost to Mycological Science by his sudden death on September 16, 1943, at the age of 71.[1] Known to most of the earlier mycologists by his former name, Lindroth, Prof. Liro was the Professor of Plant Biology and Plant Pathology at the University of Helsinki, Finland. He occupied many important posts including the Directorship of the University of Turku in 1922.

Few persons were endowed with such keen intellect and insight in the study of smuts as late Prof. Liro. In addition to his numerous papers on the smuts of the world, his two comprehensive works, *Die Ustilagineen Finnlands*, Parts I & II, would remain for many years to come, the most authoritative treatise ever written on the subject. His clear and analytical way of judging scientific matters often made him appear to err against the world though right to himself. His treatment of the genus *Urocystis* as a synonym of *Tuburcinia* aroused quite a sensation among the mycologists. While most of the workers in the European continent accepted the views put forward by Prof. Liro about the genus *Tuburcinia*, he was sharply criticised by the American and English schools who preferred to bring Article 4 of the International Rules of Botanical Nomenclature into force and thus conserve the name *Urocystis*. He made valuable contributions to the study of rusts of Finland. In addition to these, he was deeply interested in entomology having made detailed studies in the gall mite genus *Acarina*. Two genera were named in his honour, *Liroa*, a genus of smuts, by Prof. R. Ciferri, and *Lindrothia* (= Puccinia), a rust genus, by Dr. H. Sydow.

M. J. THIRUMALACHAR.

1. E. Kitunen in *Ylipainos Maataloustieteellinen Aikakauskirja*, 1943, 15.

# LETTERS TO THE EDITOR


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## VARIATION OF THE APPARENT SHAPE OF THE SKY WITH INTENSITY OF ILLUMINATION

Miller and Neuberger[1] have recently reported some measurements of the apparent shape of the sky under different meteorological conditions. Their observations are entirely confined to the day-time sky. The only available data relating to the shape of the night sky are from measurements made by Reimann[2] on different moon-lit and moonless night skies. Little effort has, however, been made so far to examine how the apparent shape of the sky varies with the intensity of illumination in the sky. In order to investigate this, it is essential that continuous observations should be made as the sun sets or rises, under clear weather conditions. The results obtained by the author under such conditions at Madras are described in this article.

It is satisfactory, for all analytical purposes, to assume a circular profile for the meridional section of the sky. The angular elevation of the mid-point of the arc joining the horizon to the zenith, called the half-arc angle, is fairly sensitive to the variation of the sky shape. An accurately-calibrated angle-meter has been used to measure the angle. It is easily seen that if the sky is observed from a point O and the distances from O to the horizon and the zenith are respectively OH and OZ, the half-arc angle will then be larger, the higher the zenith or the less distant the apparent horizon.

The results of the measurements on two different days of clear sky at the time of sunset are given in Table I. Each of the values given in this table is the mean of 16 measurements made in four different directions and thus represents the mean sky shape at the time. The quantity $\rho$ in this table is the ratio OH/OZ calculated from the average values of the half-arc angle.

Table I

| Time of observation→ | Minutes before sunset | | | At sunset | Minutes after sunset | | | |
|---|---|---|---|---|---|---|---|---|
| | 30 | 20 | 10 | | 10 | 20 | 30 | 50 |
| 28-12-'45 .. | .. | 27·5° | .. | 26·3° | 25·0° | 24·9° | 25·0 | 24·7 |
| 18-1-'46 .. | 27·4° | 26·8° | 26·3° | 25·9° | 24·8° | 24·5° | 24·7° | 24·7° |
| $\rho$ | 2·67 | 2·73 | 2·54 | 2·87 | 3·02 | 3·08 | 3·01 | 3·08 |

The author's values for the half-arc angle for the day-time, moonless and full-moon skies are given in Table II. These are the arithmetical means of a number of observations made on different days of clear weather. The values arrived at by Reimann are also included in this table for comparison.

TABLE II

| Kind of Sky→ | Day Sky | Full-moon Sky | Moonless Sky |
|---|---|---|---|
| Author .. | 27·5° | 25·2° | 24·2° |
| Reimann .. | 22·4° | 26·6° | 30·0° |

It is seen from Table I that the half-arc angle, which has a value of 27·5° during day-time in clear weather, begins to decrease from about half an hour before sunset and continues to decrease thereafter (except for a slight rise between 20 and 30 minutes after sunset) until it attains a minimum value about an hour after sunset. The minimum value reached will lie between 24·2° and 25·2°, depending on the amount of moon-light illuminating the sky. The increase in the ratio OH/OZ shows that, with decreasing intensity of illumination, the horizon seems to drift farther and the zenith to come lower. The tendency observed on both the days for the half-arc angle to rise slightly between 20 and 30 minutes after sunset may probably be ascribed to the after-glow following sunset. The observations of Reimann in Table II, which would indicate that the half-arc angle should increase with decreasing intensity of illumination, are not supported by the author's results.

It may be noted with interest from the above tables that the intensity of illumination in the sky about 8 minutes after sunset has the same influence on the apparent shape of the sky as the full-moon well above the horizon.

Further work is in progress.

The author wishes to thank Mr. B. N. Srecnivasaiah, Meteorologist, St. Thomas Mount, Madras, for his kind interest and encouragement during the progress of this investigation.

Meteorological Office,
St. Thomas Mount P.O.,
Madras, D. VENKATESWARA RAO.
*January* 30, 1946.

1. Miller, A., and Neuberger, H., *Bulletin Amer. Met. Soc.*, 1945, **26**, 212–16. 2. Pernter, J., and Exner, F., *Meteorologische Optik*, 1922, 2nd Edn , 5–56.

## MAGMATIC WATER IN THE DECCAN TRAP (PLATEAU BASALTS), NEAR NAGPUR, CENTRAL PROVINCES

THE authors, while investigating the Deccan traps of the neighbourhood of Nagpur, visited the Boregaon quarry, about two furlongs in length and with a big face. It is situated a little north of the Nagpur-Kamleshwar Road past the milepost 3 marked on map-sheet 55 O|4. On it, however, it is wrongly marked as manganese quarry. It is really a road metal and building stone quarry in the Deccan trap. While breaking a specimen of the Deccan trap from the rock, the authors observed a very unusual and interesting phenomenon. As soon as the piece was detached, a small amount of water, which was enough to wet part of the rock splashed from inside. It was carefully examined whether it could be meteoric water and whether any rain or surface water could have percolated or soaked into the rock by any means. The rock is igneous and impervious to water and no percolation or soaking was possible. The extensive quarry was perfectly dry and not a drop of water was seen issuing from even well-marked joints. The original location of this rock was right into the interior and was exposed after considerable vertical and lateral blasting. On further examination it was found that this water issued from a vesicle right inside the rock which was almost at the base of the quarry. It was an astonishing experience and the authors started investigating the occurrence of such water. Evidently, the steam, i.e., water above critical temperature, inside the vesicle being right into the interior of the flow, could not escape and had congealed into water on the lowering of temperature or the cooling of the rock. It may be noted that Dr. (now Sir) L. L. Fermor has recorded a similar occurrence of water while breaking a block of Bhusawal cores in an attempt to collect chlorophæite.[1] As this happens to be the second observation of this peculiar and rare occurrence of water in the Deccan trap it has been deemed advisable to place it on record.

Unfortunately, the volume of water being small and the authors being unaware of its concealed existence, it was splashed. The association of steam with volcanic phenomena is familiar but its actual condensation into water and its having remained trapped in a vesicle since the close of the Mesozoic era for about forty million years is a phenomenon not commonly recorded in geological literature.

From the study of rocks and other experiments, the hydrous character of the natural magma has been concluded but here is definite evidence about its free occurrence in the rock itself which should put any doubt whatsoever, at rest. Thus the magma of the Deccan trap (plateau basalts), which is believed to be the primary basaltic magma, was definitely hydrous. Under the microscope some rock-forming minerals like quartz, topaz, etc., reveal the occurrence of water, particularly under high power, but the evidence in question presents an indubitable and definite megascopic evidence.

The occurrence of water in the magma is known to lower the viscosity or increase the fluidity of the magma. It is actually known that some of the flows of this lava have travelled sixty miles or even more. Then as contrasted to pyrogenetic minerals, there is the formation of hydatogenetic minerals, i.e., those which crystallise in the presence of water. There occur a host of the latter minerals in the Deccan trap.

The mineral and chemical composition of the Deccan trap, which has yielded this free water,

is described briefly below. The rock is almost black or greyish-black in colour. It may be compact but vesicular and amygdaloidal varieties are common. A vesicle may attain the maximum size of one to two cm. in diameter. The various flows reveal a variation in texture. Under the microscope the rock resolves itself into a palagonite-bearing dolerite with a subophitic texture. It is composed of labradorite, augite, magnetite with intersertal primary glass. Palagonite has both brownish and greenish colour. The primary glass is usually of pink colour but it also occurs in irregular patches of green colour. Microlites and small crystals of felspar, magnetite and augite occur as inclusions in primary glass. There is evidence to show that augite, felspar and magnatite along with glass have crystallised simultaneously. Chlorophæite is also present in small amounts showing clear fibrous structure. In a few cases augite is seen altering to brown palagonite in successive stages. In some rocks orthoclase occurs in very small amounts and primary glass may be almost absent. A little apatite is also present as an accessary.

Both the amygdaloidal and compact varieties of the Deccan trap from this locality were analysed by Mr. B. N. Chaturvedi.

| | I | II |
|---|---|---|
| $SiO_2$ | 48·08 | 46·85 |
| $Al_2O_3$ | 13·85 | 13·28 |
| $Fe_2O_3$ | 5·50 | 7·52 |
| FeO | 10·20 | 6·70 |
| MgO | 4·00 | 6·55 |
| CaO | 10·70 | 11·96 |
| $Na_2O$ | 2·71 | 2·85 |
| $K_2O$ | 1·08 | 1·21 |
| $H_2O^+$ | 1·10 | 1·02 |
| $H_2O^-$ | 0·56 | 0·42 |
| $TiO_2$ | 2·80 | 2·60 |
| | 100·58 | 100·96 |

(1) Amygdaloidal dolerite from Boregaon quarry, near Nagpur.
(2) Compact dolerite from Boregaon quarry, near Nagpur.

These analyses contain 1·10 and 1·02 per cent. of combined water apart from the free water mentioned above. The average percentage of combined water of 11 analyses of these basalts by H. S. Washington is 1·70, while the maximum represents 3·2 in a basalt from the Kurli Hill, Baroda State.

H. L. Chhibber.
B. N. Chaturvedi.

Benares Hindu University,
*November* 10, 1945.

1. *Rec. G. S. I.*, 1926, **58**, 128.

## DECOLORISATION OF NICOTINIC ACID EXTRACTS

Acid hydrolysates from plant products and animal tissues being deeply coloured have to be decolorised before treating with the cyanogen bromide-aniline hydrochloride reagent for the colorimetric estimation of niacin. Most of the suggestions for decolorising these extracts are unsatisfactory. With charcoal, fuller's earth, permutit, etc., a fairly high percentage of niacin is found to be adsorbed, while with Pb-acetate and $Hg(NO_3)_2$, there was interference of the anions with colour development.[1,2]

According to the recent method of Friedemann and Barborka,[3] the decolorisation is brought about by $Zn(OH)_2$ precipitated within the solution by NaOH. Significant features of this method are that (i) pH of the solution is adjusted to 6-7—a condition pre-requisite to the treatment with the reagent, (ii) ionic interference is not likely since the $Zn(OH)_2$ is very little soluble at pH 6-7 and (iii) zinc hydroxide does not adsorb nicotinic acid.

Using this method, we succeeded in decolorising to a great extent the acid hydrolysates from cereals. However, on subsequent treatment with the reagent we found that the solutions developed a reddish tinge which interfered with the colour matching. The intensity of the colour varied with different cereals; *e.g.*, with wheat (*Triticum vulgare*) it was cobalt red and with ragi (*Eleusine coracana*) it was slightly reddish.

Attempts were then made to selectively remove this red colour with solvents like chloroform, ether and petrol-ether without affecting the yellow colour due to niacin. Ether and petrol-ether removed completely the red colour leaving the aqueous layer characteristically yellow (due to niacin). Chloroform was found to remove, in addition, a fair proportion of the niacin colour. Ether was found to be more suitable inasmuch as the aqueous layer shaken with it showed no tendency to emulsify as was the case with petrol-ether.

To determine if ether had any effect on the yellow compound of niacin, test solutions containing a known amount of niacin were, after the addition of cyanogen bromide and aniline hydrochloride, shaken with an equal volume of ether for two to three minutes. The colours were then compared on Pfaltz-Bauer fluorophotometer, with those of the corresponding controls without treatment with ether. The results are shown below:—

*Niacin in μg*

| Test solution No. | Treated with ether | Untreated with ether |
|---|---|---|
| 1 | 4·00 | 4·00 |
| 2 | 3·50 | 3·00 |
| 3 | 4·50 | 4·50 |
| 4 | 4·75 | 4·50 |
| 5 | 4·00 | 4·50 |
| Mean | 4·15 | 4·10 |

Ether does not remove the characteristic yellow colour due to niacin.

R. G. CHITRE.
D. B. DESAI.

I.R.F.A. Nutrition Research Unit,
Seth G. S. Medical College,
Parel, Bombay (12),
*January* 8, 1946.

1. Giri, K. V., and Naganna, B., *Ind. Jour. Med. Res.*, 1941, **29**, 585. 2. Bandier, E., and Hald, J., *Biochem. J.*, 1939, **33**, 264. 3. Friedemann, T. E., and Barborka, C. L., *J. Biol. Chim.*, 1941, **138**, 785.

## CHEMICAL COMPOSITION AND PHYSICAL CHARACTERISTICS OF SOME NATURAL FATS AND OILS

THE recent contribution by Achaya and Banerjee[1] makes it desirable that we should announce the line of work on which we have been engaged for some time and to summarise the theoretical basis of our work. Natural glycerides, as products of a series of complex metabolic processes, need not be expected to conform to the exact demands of any numerical formula. Nevertheless, a critical study of published data reveals regularities too pronounced to be accidental.

Two physical determinations usually carried out on fats and oils are the melting points and titre values. A little reflection would show that both these are functions of the acid content—the higher the saturated acid content the higher the two values. As far as we are aware no one seems to have tried to work out any relation between these values and the actual and potential trisaturated glyceride content (the potential value being calculated from the saturated acid content). Let us take the case of coconut oil. The m.p. and titre as given in literature[2] are 23 to 26 and 20 to 23 respectively (variation due to different samples). The molecular percentages of saturated acids[3] are, for two samples, 93·9 and 92·9 respectively. The cube of these concentrations expressed in percentages are 82·8 and 80·3 as against the experimental values (for fully saturated glycerides) 86 and 84 respectively. The difference between the experimental values and the "cube-value" is, approximately, 3. In this case the experimental value is higher than the cube-value, and fats and oils showing this characteristic we propose to call "Positive Fats". Fats of the palmæ and internal depot as well as milk fats of the higher animals belong to this class. Under "Negative Fats" are included vegetable glycerides which do not contain any appreciable amounts of acids lower than myristic, external fats of higher land animals as well as fats of the lower animals. Borneo tallow is an example of a negative fat. Its m.p. and titre values are 31 and 51 respectively. The molecular percentage of saturated acids are 62·9 and 62·8 (the cube-value being 24·9 and 24·8) as against the molecular percentage content experimental of trisaturated glyceride: 5·1 and 4·5. The difference in both values is 20 and the titre value being higher than the m.p.

The negative fats have a peculiarity of their own. The observed constancy of difference noted is a function of the unsaturated acid content also. Available data reveals that the constancy of difference is maintained till the molecular concentration of the unsaturated acids reaches 48 per cent. From 48 to 62 the difference between the experimental values for fully saturated triglyceride and the cube-value is half the difference between the titre and m.p. From 62 to 68 the value becomes a quarter and from 68 to 71 it is one-eighth. The last case requires further scrutiny before being accepted with confidence. Another interesting fact about negative fats is also worth recording and may be illustrated by an example:—

Let the unsaturated and saturated acid content be 48 per cent. and 52 per cent. Then the cube-value (saturated acid) is 14, a figure identical with the value by which the negative fats falling under the second category (48 to 62) differ. The corresponding figures for the second and third cases are 5·5 and 3·5 respectively.

What the exact interpretation of the above we are not in a position to say but we hope that the work engaging our attention would help in this direction.

A. R. SUKUMARAN KARTHA.
K. N. MENON.

Maharaja's College,
Ernakulam,
*January* 30, 1946.

1. Achaya and Banerjee, *Curr. Sci.*, 1946, **15**, 23. 2. Lewkowitsch, Vol 2. 3. Hilditch, *The Chemical Constitution of Natural Fats.*

## TAMARIND SEED "PECTIN"

OUR earlier observation,[1] that the alcohol precipitate from an aqueous extract of tamarind seed kernel[2] differs fundamentally from fruit pectins, in spite of its forming a well-set jelly in presence of appropriate amounts of sugar and acid, has since been confirmed by other workers.[3,4] The evidence in regard to the identity of the sugars obtained is, however, conflicting. This communication records the results of our further studies on the chemical nature of this polysaccharide fraction.

A comparative study of different methods of purification of the alcohol precipitate[2] showed that the most convenient method for the removal of proteins was the one already described.[1] The alternative method of Ghose and Krishna[4] was not quite satisfactory as, by this procedure, extraction was incomplete and the proteins were only partially removed while, regeneration of the substance after precipitation as copper salt yielded a discoloured product.

The purified tamarind seed preparation,[1] unlike fruit pectins, does not reduce Fehling's solution except when hydrolysed with acids. Using different concentrations of acid and varying periods of hydrolysis, it was observed that the maximum liberation of reducing sugars resulted on hydrolysis with 3 per cent. sulphuric acid for 8 hours. Expressed as glucose, this amounted to 41·5 per cent. of the weight

of the substance, suggesting considerable destruction of sugars during hydrolysis[5] although a value as high as 83 per cent. has been reported under similar conditions;[3] that destruction of sugars could happen was, however, shown conclusively using mixtures of known amounts of different hexoses and pentoses. Taka-diastase, 0·1 per cent., while without action on fruit pectins, hydrolyses the product from tamarind seed meal giving 30 per cent. reducing sugars after 48 hours incubation at room temperature. The only sugars that could be identified in these hydrolysates were xylose, galactose and glucose. From the yields of furfural on distillation with 12 per cent. hydrochloric acid[6] and of mucic and saccharic acids on oxidation with nitric acid of specific gravity 1·15,[7] the percentages of these sugars were calculated as 28·42, 16·19 and 55·36 respectively, corresponding, approximately, to a molecular proportion of 2 : 1 : 3. It cannot be stated at present whether the gluco-galactoxylan has a ring[8] or a chain structure.[9] No methyl ester groups could be estimated using any of the improved methods[10] while the uronic acid residues[11] amounted only to 3·44 per cent.

These observations on the nature of the products of oxidation and hydrolysis are in general agreement with those of Ghose and Krishna[4] and do not support the claims made by Damodaran and Rangachari,[12] particularly regarding the presence of arabinose among the products of hydrolysis. The discrepancy is explained by the latter authors as "unimportant"[12] and as due to the inhomogeneous nature of the preparation. While, as already reported, we have succeeded in obtaining a preparation of fairly constant composition to which the foregoing studies were confined, we feel that conditions of extraction and precipitation can only alter the proportion but not the nature of the existing constituents in the polysaccharide fraction.[13,14]

Other observations of interest are summarised here. The purified preparation of the tamarind seed meal is dextro-rotatory. The acid number is low[1] but treatment with decinormal alkali for varying periods of time is followed by increased use of the latter as shown by back titration with standard acid; the acid value at the end of 48 hours increasing to over 500 milli-equivalents per cent. of carboxyl group (over 20 times the original). Similar behaviour is shown by fruit pectins as well as other gums and mucilages where this phenomenon could be explained as due to de-esterification and liberation of acids.[15] With tamarind seed preparation, however, the fact that the gel-forming constituent can be recovered even after boiling with excess of decinormal alkali,[1] precludes the possibility of any alteration or splitting of the polysaccharide. Further work is obviously needed to throw more light on this phenomenon.

The only property which tamarind seed preparation shares with fruit pectins would thus appear to be in its formation of sucrose-acid jellies. Even here, it has been observed that the jellies, under all conditions, are tougher in consistency than those obtained from fruit pectins. A study of sugar-acid jellies with tamarind seed preparation using an apparatus similar to the pectinometer of Luers and Lochmüller[16] showed that they had greater gel strengths than the corresponding jellies of fruit pectins and that gel strength was quite unrelated to associated proteins in impure preparations,[2] there being a steady increase following their removal.

Further details will be published elsewhere.

G. R. Savur.
A. Sreenivasan.

Foods and Drugs Section,
Dept. of Chemical Technology,
University of Bombay,
Bombay 19,
*February* 5, 1946.

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## CHEMOTHERAPY OF SOME ACRIDINE DERIVATIVES IN FOWL MALARIA

THE best method of combating malaria is to prevent infection by suitable anti-mosquito measures, but these can be carried out by relatively rich and well organised communities. While the cinchona alkaloids are still the most widely used antimalarial drugs, cinchonine is less effective than quinine against malaria,[1,2,3,4] by virtue of the former's undue toxicity to heart, lower partition coefficient, and inability to prevent the emigration of leucocytes. Following the elucidation of the general formula of the cinchona alkaloids,[5] the seat of the antimalarial activity in the quinine was attributed to the quinoline part of the molecule. This suggestion led to the synthesis of a number of substituted quinoline derivatives containing 8 or 4-alkylamino side-chains with or without a secondary alcohol,[6,7,8] of which plasmoquine proved to be powerful synthetic antimalarial. The success which was met with in the use of acridine derivatives as antiseptics[9,10] led to the search for antimalarials in the acridine ring system. In 1930 Mauss and Mietzch reported the synthesis of the dihydrochloride of 2-methoxy-6-chloro-9-(8-diethylamino-α-methyl butyl amino) acridine called atebrine. Atebrine is reputed to be less toxic than plasmoquine and compares favourably with quinine in destroy-

ing the parasites in the blood by acting on the trophozoites of all the three types of the parasites.[11,12,13] Though the synthesis of atebrin has stimulated the search for new synthetic antimalarials,[14,15,16,17,18] the drug treatment of malaria has been shown to be ineffective even under optimum conditions, owing to two fundamental disadvantages inherent in the drugs now in use. First, these drugs do not destroy all the parasites in the human host and thus prevent the possibility of a relapse and consequently a constantly increasing carrier-reservoir accumulates tending to the spread of malaria. Secondly, these drugs have no action on the sporozoite stage of the parasite and hence cannot prevent the development of clinical malaria following the bite of an infected mosquito.[19] Search for synthetic antimalarial drugs must take cognisance of these inherent defects.

In this communication, the results of our investigation of the antimalarial properties of products analogous to atebrin, obtained by introducing carbamido, semicarbazido, thiocarbamido, thiosemicarbazido and also their corresponding alkyl substituted derivatives in the usual atebrin nucleus, have been recorded. The alkyl substituent as in the case of atebrin was 'd-diethyl-amino-α-methyl-butyl' group. A number of compounds were obtained and their efficacy in fowl malaria was tested; the results are given in Table I.

EXPERIMENTAL

English fowls, of an average weight of 350-400 gm., were inoculated with intramuscular injections of 0·5 c.c. of citrated blood from fowls infected with *P. gallinaceum*. One group was treated with the compounds to be tested and a second group with mepacrine hydrochloride, while a third batch was kept as control. In the freshly inoculated fowls the parasites usually appeared on the seventh day after inoculation and the infection was considered to be very heavy on the ninth day. Both mepacrine hydrochloride and the substance to be tested were given in doses of 1 mg. per 20 gm. body-weight,[20] intramuscularly on the day following the appearance of the parasites in the blood, when the infection was considered to be moderate. The injections were continued for three successive days, and the blood slides were examined every day and also for several days after the last injection. The antimalarial properties of the substances were judged by their effects on the rate of disappearance of the parasite from the blood and also by the morphological characteristics of the parasite. A curative result was recorded when parasites could not be detected on thin films after repeated examination for several days following the day of disappearance. The results are tabulated below (see table).

From an analysis of the table it can be seen that out of the six compounds tested, only two are active against *P. gallinaceum*—2-chloro-7-methoxy-5-carbamido and 2-chloro-7-methoxy-5-thiocarbamido acridine—and the results compare very favourably with mepacrine hydrochloride. One of the fowls treated with the compound (1) showed slight relapse after 12 days, but it was only transient and the parasites disappeared from the blood on the next day, and could not be detected for a period of one month. In the case of compound 2, two similar cases of relapse of a transient nature were noted. With the fowls treated with mepacrine one case of relapse was noted. All the untreated fowls kept as control died ten days after inoculation as a result of heavy infection.

TABLE I

| Name of the compounds | Activity against fowl malaria |
|---|---|
| 1. 2-chloro-7-methoxy-5-carbamido acridine | + |
| 2. 2-chloro-7-methoxy-5-thiocarbamido acridine | + |
| 3. 2-chloro-7-methoxy-5-semicarbazido acridine | − |
| 4. 2-chloro-7-methoxy-5-thiosemicarbazido acridine | − |
| 5. 2-chloro-7-methoxy-5-(δ-diethyl-amino-α-methyl) -butyl semicarbazido acridine | − |
| 6. 2-chloro-7-methoxy-5-(δ-diethyl-amino-α-methyl)-butyl thiosemicarbazido acridine | − |

It is interesting to note that introducing carbamido and thiocarbamido substituent in the usual atebrin nucleus does retain the antimalarial property of the resultant compounds, so far as fowl malaria is concerned.

Further study in detail is in progress.

Our thanks are due to Dr. K. P. Menon for his kind interest and help during this investigation, to the authorities of the King Institute of Preventive Medicine, Guindy, for supplying strains of *P. galliniceum*, and to Prof. P. C. Guha and Mr. S. P. Mukerjee of the Organic Chemistry Laboratory, Indian Institute of Science, Bangalore, for supplying the various compounds studied.

B. K. BHATTACHARYA.
S. NATARAJAN.
N. N. DE.

Pharmacological Unit,
Indian Institute of Science,
Bangalore,
*January* 22, 1946.

1. Giemsa, *Arch. Schiff. Tropen. Hyg.*, 1914, **18**, 12. 2. Meldolesi, *Cuore Circulat.*, 1925, **9**, 353. 3. Ikeda, *J. Pharmacol.*, 1916, **8**, 101. 4. Shaw, *Amer. J. Hyg.*, 1928 **8**, 583. 5. Henry, T. A., *Plant Alkaloids*, 1939, **413**. 6. Ruzicka, *et al.*, *Hel. Chem. Acta.*, 1924, **7**, 995. 7. Pymann, *J. Chem. Soc.*, 1917, 1103. 8. *D. P. R.*, 541730, 1925. 9. Browning, *et al.*, *J. Pathol. Bact.*, 1924, **27**, 121; *Proc. Roy. Soc.*, 1922, **93**, 329. 10. Jodlbauer and Salvendi, *Arch. int. Pharmacodynamie.*, 1905, **15**, 223. 11. Kikuth, *Deutsch. med. Wochenschr*, 1932, **58**, 530. 12. Green, *Lancet.*, 1932, **222**, 826. 13. *Annual Report of the Public Health Commissioner to the Govt. of India*, 1932. 14. Walls, *J. Chem. Soc.*, 1935, 1405. 15. Clemo and Hook, *J. Chem.*, 1936, 608. 16. Robinson and Baldwin, *J. Chem. Soc.*, 1929, 2959. 17. Stukov and Magidson, *Arch. Pharmacy*, 1933, **271**, 569. 18. Robinson, *J. Chem. Soc.*, 1929, 2948. 19. Sollmann, T., *Manual of Pharmacology*, 1942. 20. Mukerji, B., Ghosh, B. K., and Siddons, L. B., *Ind. Med. Gaz.*, 1942, **77**, 723.

## EFFECT OF QUALITY OF STARCH ON DRY-CELL PERFORMANCE

STARCH, agar-agar and dextrin are used in dry-cell manufacture to render the electrolyte unspillable; starch is the most widely used. Experiments carried out in a dry cell manufacturing concern at Bombay making use of locally available starch, revealed that the cell performance was not up to the standard specifications. Therefore, attempts were made to find whether any improvement in the quality of starch would show betterment in the performance of dry-cells produced.

The starch obtained from the market was found to contain about 16 per cent. non-starchy matter. After purification the starch (containing 0·5 per cent. impurities) was employed in making dry-cells.

| Starch sample | Initial voltage | Amps. | Continuous burning hours (till voltage drops to 0·6) |
|---|---|---|---|
| 1. Unpurified | 1·55 | 5·2 | 6 hrs. 30 mts. |
| 2. Purified | 1·55 | 6·5 | 9 hrs. 45 mts |

Improvement in the cell performance is (see Table) brought about by using purified starch which probably possesses better gelatinising properties. This is in conformity with a previous observation[1] that starch is better than flour for the manufacture of dry-cells.

Department of Technology,
Andhra University,
Guntur, D. VENKATESWARLU.
*February* 11, 1946.

1. Joglekar, Subba Ramiah and Verman, *Indian Industrial Research Bulletin*, No. 23, p. 17.

## COMPLEX COMPOUNDS OF MERCURIC CHLORIDE

MR. A. K. DEY has published a note in *Current Science* (January 1946, p. 24) on "Chloromercuric acids", wherein it is stated that he has obtained evidence from conductivity data for the existence of (1) $H HgCl_3$, (2) $H_2HgCl_4$ and (3) $H_4 HgCl_6$ and also for the corresponding potassium salts.

It happens that a parallel investigation is being carried out here on the complex compounds of $HgCl_2$, where conductivity is one of the properties studied and the preliminary results were communicated to the Indian Science Congress (paper 12, p. 118, *Abstracts*, 1945; and paper 66, p. 18. *Abstracts*, 1946). I have reported the existence of three compounds of the formulæ.

(*a*) $2KCl.HgCl_2$, (*b*) $KCl.HgCl_2$, (*c*) $KCl.2HgCl_2$. The possibility of other complex compounds is under investigation. Compounds (*a*) and (*b*) correspond to (2) and (1) of Dey. In my case the evidence for the existence of the compound $KCl.2HgCl_2$ is unmistakable.

Further, according to Mr. Dey, "the mixture was more conducting than either constituent and the conductivity values were even greater than the sum of the conductivities of the constituents". My observation is just the reverse. Starting with a solution of KCl of fixed concentration increasing quantities of $HgCl_2$ were added. It was found that the original conductivity of KCl *decreased* and the plot was not regular, but gave kinks with abnormal decrease of conductivity at concentrations corresponding to the compounds listed.

Another observation was that the cell constant of the conductivity cell (with platinum electrodes) always decreased appreciably when the cell had been in use for some time with solutions containing $HgCl_2$.

Details will be published later.

Department of Chemistry,
The University,
Lucknow, L. N. SRIVASTAVA.
*February* 5, 1946.

## FURTHER NOTE ON AN IMPROVED METHOD OF LOCATING TANNINS IN PLANT SECTIONS

SINCE the publication of the note entitled "An improved method of locating tannins in plant sections" in *Current Science*,[1] further work has successfully removed certain shortcomings, inherent in the former method. This has been made possible by the use of the new preparation of one of the reagents, i.e., solution A according to Snell and Snell.[2] The original preparation involves large quantities of chemicals which are wasted because the preparation deteriorates on storage and a few drops of the reagent are only needed for staining a dozen or more sections at a time. Snell's method has, therefore, been modified and is described below.

### PREPARATION OF THE REAGENT

*Solution A.*—2.25 gms. of phosphotungstic acid, 0·5 gm. of phosphomolybdic acid and 2 c.c. of syrupy phosphoric acid are taken in a 200 c.c. conical flask to which are then added 20 c.c. of distilled water. The mixture is then boiled over a water-bath under reflux for two hours, allowed to cool. 4 gms. of lithium sulphate solution, one drop of bromine and 2 c.c. of concentrated hydrochloric acid are added to the mixture which is then boiled for 20 minutes without any condenser and allowed to cool. The mixture is then diluted to 50 c.c. instead of 25 c.c. as in the previous preparation.[1] The mixture can as well be diluted to 100 c.c. and this solution is also good enough for staining plant sections in the majority of the cases but in the case of plant materials extremely low in tannin content, the staining is not so prominent in contrast as with the stronger solutions.

Lithium carbonate can alternatively be used in place of the sulphate in which case more of the concentrated hydrochloric acid has to be added in order to decompose all the solid carbonate. All other operations are just the same as above.

The preparations are yellow in colour and free from any green tinge which is indicative of the presence of reduction products. The reagent must be preserved in amber coloured bottles, wrapped in black paper and well protected against dust as organic materials tend to reduce the strength rapidly.

PROCEDURE

Procedure is the same as in (1). After passing the stained sections through the various grades of alcohol they are cleared either in xylol or clove oil and then mounted in balsam if permanent sections are necessary.

It has been observed that in the winter season the use of a still lower grade of alcohol as 20 per cent. may be found necessary in order to effect a better clarification of the plant sections.

This method can most profitably be utilised in quickly identifying the presence or absence of tannins in the various plants or plant parts by staining their sections with solution A and neutralising with solution B and immediately examining them under a microscope without trying to prepare any permanent slides at all. The portions of the plant sections containing more or less tannin accumulations are stained deep or light steel blue which can be seen at a glance under a microscope.

ADVANTAGES OF THE NEW PREPARATION

The few advantages of this new preparation are as follows:—

Firstly, the preparation of the reagent (*i.e.*, solution A) is highly economical as it entails the barest minimum quantities of the chemicals for the purpose; secondly, in order to get equally good effects, half the volume of the reagent is only necessary than the former preparation; thirdly, no cloudy-white precipitate is formed even if an excess of the reagent is by chance added and fourthly, there is no immediate hurry, as in the former method, in passing the stained plant sections through the various grades of alcohol for washing them.

A list of the new plant materials wherein the presence of tannins has been demonstrated by this preparation, is given below:—

TWIGS.—*Ægle marmelos, Artocarpus integrifolia, Citrus decumana, Crotalaria* sp. (Atoshi), *Duranta Plumieri, F. bengalensis, F. religiosa, Eugenia jambolana, Glycosmis pentaphylla, H. sabdariffa* var. *altissima* (red and white), *Nephelium Litchii, Psidium Guava, Spondias Mangifera, Zizyphus jujuba.*

Jute Agricultural Research Laboratories, Dacca, Indian Central Jute Committee,
*July* 27, 1945. A. C. BOSE.

1. Bose, A. C., *Current Science*, 1943, **12**, 327.
2. Snell, F. D., and Snell, C. T., *Colorimetric Methods of Analysis*, **2**. Second printing. New York, p. 351.

## HAIR BALL IN THE STOMACH OF A CALF

'PICA' or perversion of appetite is known in various animals including man. Habit of eating materials, which are not normally included in the diet of the species sometimes arises out of physiological needs. Cattle, fed with diet poor in calcium, may take to bone eating. Wool eating in sheep and hair licking in calves may be due to parasitic infection of skin or may be due to parasitic infection of skin or may be a simple perversion of habit. This habit frequently gives rise to hair balls in the stomach resulting in disturbances of digestion with ultimate minor or grave consequences. Death due to obstruction of alimentary canal is not rare.

In this laboratory, recently, a hair ball was found in the stomach of a male calf of four months age. It was a globular elastic solid mass closely resembling an ordinary tennis ball in shape, colour and external appearance. Only the size was just a bit larger. On breaking in two equal halves the ball was found to consist almost solely of large number of dark black hairs interwoven very closely with practically no cementing material. Beneath the outermost thin layer of muddy white colour, another concentric layer of dark black hairs was clearly distinguishable; this second layer was about half centimetre in thickness. Inside this layer the arrangement was that of a closely packed irregular lump. The individual hairs were long. The uniform colour, thickness, shape and size of the hairs suggested that they were devoured from the same source. The calf itself was completely white. So the hairs must have been obtained from some other animal, very likely its mother.

The calf was well nourished and as far as could be gathered in spite of its size, the ball produced no symptoms in the animal.

The diameter of the ball was 4 inches; weight was about 50 grams. The length of individual hair varied from 1 to 1·5 cm.

Bengal Immunity Laboratory, Calcutta, DIPTISH CHAKRABORTY.
*January* 27, 1946.

## FLUORIDE INTOXICATION ANÆMIA IN CATTLE

ANÆMIA has been recognised as one of the clinical features of fluoride intoxication in animals and man. Several workers—Valjavec[5] (1813); Leake and Ritchie[2] (1926); Slagsvold[4] (1924); Roholm[3] (1937)—have studied the effect of fluoride salts on the blood-picture of animals; from the standpoint of clinical hæmatology, the available data do not clearly indicate the type of anæmia present. In none of these publications, moreover, has any reference been made to the possible correlation of blood changes to pathological processes elsewhere in the body. Thus the exact pathogenesis of anæmia induced by fluoride intoxication has escaped the attention of previous workers. The present note contains observations on these aspects arising from our studies on the pathology of experimental fluorosis in cattle.

Our interest in the study of this symptom-complex was prompted by finding certain pathological changes in the bones and the marrow of fluoride-fed animals. Pande[1] (1944) has shown that in cattle fed with NaF at the rate of 3 to 4 mgm. per kgm. body-weight, gelatinous degeneration of the bone marrow

occurs. The red marrow in the metaphyses of long bones and the ribs tends to disappear under the stress of abnormal disposition of young trabeculæ formed by metaplasia. Histologically, in these parts, active hæmopoiesis is absent and the marrow consists principally of reticulum and osteoblasts.

When compared with those of normal cattle, the number of the erythrocytes was low, the packed cell volume figures were approximately the same and the hæmoglobin content was reduced although the mean corpuscular values appeared to be higher both with regard to the mean corpuscular hæmoglobin and mean corpuscular hæmoglobin concentration. Cells representing immature stages in the development of the erythrocytes could not be found in stained preparations of blood.

Leucocytic count of the fluoride-fed animals was found to be unaffected. Cells characterised by the presence of nuclei of shapes varying from a band to a horse-shoe-shaped appearance were frequently seen and when determined by the peroxidase reaction were found to be young granulocytes. On differential count the lymphocytes were found to predominate over the neutrophils.

Among animals and man, fluoride intoxication causes a considerable damage to the marrow element; this in the case of domestic animals manifests itself as gelatinous degeneration, and as osteosclerosis in man and also in the rat. In both instances, however, the marrow loses its capacity for blood regeneration, and the consequent anæmia may thus be considered as aplastic in type when viewed from the point of pathogenesis. From the morphological standpoint, however, the fluoride intoxication anæmia of cattle, as investigated by us, is macrocytic and hyperchronic as the figures for the mean corpuscular volume fall within the normal range and those for the mean corpuscular hæmoglobin and the mean corpuscular hæmoglobin concentration are found to be higher than the normal values for cattle.

P. G. Pande.
J. M. Lall.

Animal Nutrition Section,
Imperial Veterinary Research
Institute, Izatnagar,
*December* 24, 1945.

1. Pande, P. G., *Ind. J. Vet. Sc. & Anim. Husb.* (in press), 1945. 2. Leake, C. D., and Ritchie, G., *Am. J. Physiol.*, 1926, **76**, 234. 3. Roholm, K., *Fluorine Intoxication*, H. K. Lewis, 1937, London. 4. Slagsvold, L., *Norsk. Veterinær-Tidsskr.*, 1934, **46**, 2 (quoted by Roholm, 1937). 5. Valjavec, M., *Z. ges. Exp. Med.*, 1932, **85**, 382 (quoted by Roholm, 1937).

## MANGO-SEED KERNEL—A NEW SOURCE OF FOOD

According to a recent estimate the concentrates available in India are sufficient only for 29·1 per cent. and fodder for 78·5 per cent. of the adult bovine population. This does not take into account the requirements of goats, sheep and equines. The shortage is further accentuated during periods of famine. In order to meet these shortages, the Nutrition Research Laboratories at Izatnagar have been exploring new sources of foodstuffs. This investigation relates to the use of mango-seed kernel as a cattle and human food. At present, the material is thrown away as a waste. From chemical analysis of the kernels it has been found to be rich in protein, carbohydrates and fats (crude protein 8·50, ether extract 8·85 and soluble carbohydrate 74·49 per cent. on dry matter basis).

It was incorporated with the ration of bullocks to the extent of 50 per cent. of digestible protein. The animals took two to three weeks to acquire a taste for the kernels but later relished it. During the observation period of three months the animals gained an average of 33 lbs. in weight and also developed a healthy appearance and fine condition.

Results from a metabolic experiment on three country bullocks show that the animals were in positive balance with regard to N, Ca and P. The digestibility coefficients of crude protein, ether extract and soluble carbohydrates were 72, 56 and 70 per cent. respectively. The digestible protein and starch equivalent per 100 lb. dry matter of the kernel were 6·1 lb. and 67·5 lb. respectively. These figures can be favourably compared with other grains, *e.g.*, maize, barley and oats.

The observations merit mango-seed kernel a place in the category of food-grains and make available every year about 70 million pounds of digestible protein and 780 million pounds of starch equivalent from a hitherto unutilised source. It has also been calculated that the digestible protein obtained from 80 lb. of oats is equal to that of 100 lb. of mango-seed kernel and the starch equivalent from 86 lb.

The supplementary values of mango-seed kernel flour were found out by partial and total replacement of wheat and maize from the stock diets, by using rats as experimental animals. Observations were made to find out the effect on growth and reproduction of rats over a period of three generations. The biological values of protein, as determined by growth and balance sheet methods, show no declination when mango-seed kernel flour replaced 60 per cent. of the wheat or maize quota in the stock diets. The difference was, however, found to be significant when the wheat or maize was totally replaced by mango-seed kernel flour. The hæmoglobin, plasma protein, albumin|globulin ratio, non-protein-nitrogen content of blood and percentage of bone-ash show no significant difference between the stock diet and the mango-seed kernel groups. The liver vitamin A content was found to be higher in the mango kernel group.

The details will be published elsewhere in two parts.

Our grateful thanks are due to Dr. F. C. Minett for his constant advice and encouragement in the development of these investigations.

N. D. Kehar.
R. Chanda.

Animal Nutrition Section,
Imperial Veterinary Research
Institute, Izatnagar.
*January* 19, 1946.

## THE CARBOHYDRATE-LIPOID ENVELOPE OF THE LEPROSY GERM

As is well known the Tubercle bacillus does not lend itself to ordinary staining which is now recognised to be due to a wax-like lipid which envelopes this germ; the same is also true of the leprosy germ. Following the example of Pagel who stained the Tubercle bacillus with Giemsa stain[1] I wanted to do the same with the leprosy germ.

Smears of leprous nodules were first treated with various fixatives and then with Giemsa stain but the results were all negative. Even Carnoy's fixative, which contains 30 per cent. chloroform and as such should have dissolved the waxy envelope of the leprosy germ did not give satisfactory results. A large test tube filled with Carnoy's solution was kept in a beaker of hot water and the temperature raised until the Carnoy's mixture began to boil. Slides of smears from leprous nodules were transferred from the cold into hot Carnoy's solution and kept in it for half an hour. The slides were treated with different grades of alcohols and finally brought into water and stained with Giemsa. This procedure gave ideal results. Pure chloroform or its mixtures with alcohol did not produce any happy result even on boiling. Likewise mixtures of acetic acid and alcohols even on boiling did not give satisfaction. But chloroform and mineral acids provided the mixture is heated proved as efficient as Carnoy's hot mixture. The few experiments lead us to the conclusion that the leprosy germ has an envelope of a carbohydrate-lipoid nature. In order to hydrolyse the carbohydrate acid media are necessary and not merely acid but the solutions must be hot for hydrolysis takes place much more rapidly. Once the carbohydrate is splitted up the lipoid residue can be dissolved by a solvent like chloroform and heat.

This explains why three factors are necessary—acid, chloroform and heat.

The work is in progress and it is hoped that further details will be published in due course.

Laboratory of Biochemistry,
Osmania Medical College,
Hyderabad (Dn.), S. MAHDIHASSAN.
*December* 24, 1945.

1. Kayne, Pagel and O'Shaughnessy, *Pulmonary Tuberculosis*, Oxford Press, 1939, p. 4.

## A LEAF-SPOT DISEASE OF 'JOWAR' (*SORGHUM VULGARE* PERS.) HITHERTO UNRECORDED FROM INDIA

FOR the last few years the senior author has been noticing a leaf-spot disease of *Sorghum vulgare* Pers., on the farms attached to the College. During the rainy season this year the authors noted that the disease is fairly serious in the villages near Cawnpore. This disease has, so far, not been recorded in India and appears fairly serious to warrant the attention of plant pathologists. The causal organism of the disease, so far not recorded in India, is *Titæospora andropogni* (Miura) Tai. The disease was first recorded by Miura in Manchuria and subsequently in the United States of America. A brief account of the disease has been given by Bain and Edgarton[1] and by Bain.[2]

At Cawnpore the disease is first noted in the third week of July when the crop is fairly young; and it assumes a virulent form during the end of August. The young lesions are elongate elliptic, visible on both surfaces of the leaf and 'naphthalene yellow' in colour. As they elongate the colour changes to 'Naples yellow' finally to 'cepusine buff'. As the spots mature the central portion begins to assume a darker colour, ultimately becoming grey surrounded by a 'flesh ochre' margin.[3] The colour of the margin becomes dark-red in fully matured spots. The central portion of the lesions assumes a sooty colour which is due to the initiation of subepidermal stroma. Later, numerous erumpent, spherical or subspherical black sclerotia appear on the surface; these are more prominently seen on the lower surface of the leaf and are easily brushed off. The lesions, specially those near the margin, coalesce together resulting in long streaks (Plate I). It is not unusual to find more than half the total leaf area affected. The average size of the individual lesions is 5 cm. × 1 cm.

PLATE I. Lesions caused by *Titæospora andropogni* on leaf of sorghum (× ½).

This disease has been described as the 'sooty stripe disease of sorghum' by Bain[2] who has quoted Miura's description of the fungus. According to Bain[2] it has not yet been determined whether the subepidermal black stroma is formed before or after sporulation.

Microscopic examination of the lesions showed that the tissue of the leaf is permeated with broad, hyaline, septate hyphæ which tend to be intercellular. The xylem vessels are often packed with broader hyphæ that assume a darker colour. The hyphæ accumulate in the substomatal cavity and develop dark

coloured sub-hemispherical stroma which is composed of isodiametric cells in the basal region, while the apical portion, i.e., the side facing the stroma, consists of elongated cells of lighter colour. The apical region elongates and forces apart the guard cells resulting in a wide stomatal opening (Plate II, Fig. 1). The conidiophores develop on the apical portion of the stroma within the substomatal cavity and do not extend beyond the level of the guard cells, and are closely packed, hyaline, non-septate with a truncate apex measuring 22-35× 2-3·5 μ. Their arrangement is reminiscent of a coremium. The conidia are borne at the truncate apex of the conidiophores and are cylindrical, flexuose, 1-8 septate, measuring 56-106 × 2-3·3 μ, but usually 65-75 μ long with usually one, and occasionally up to three, lateral branches measuring 16-35 × 1·7-3 μ (Plate II, Fig. 2).

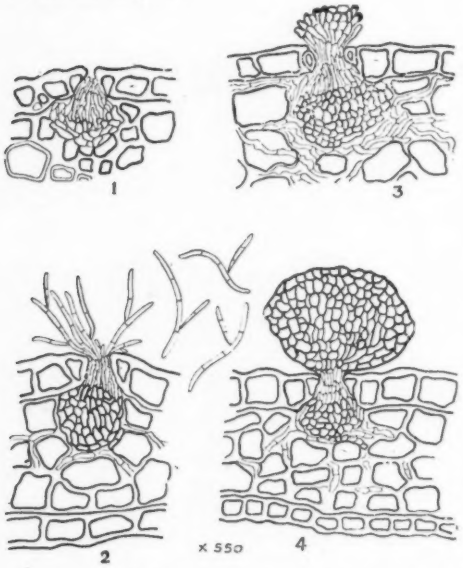



PLATE II. *Titæospora andropogonis.* 1. Section of leaf showing the formation of the stroma in the substomatal cavity. Same showing the formation of conidiophores and conidia. 3. Conidiophores pushed beyond stomatal opening and the initiation of the sclerotium. 4. Mature sclerotium.

After the sporulation is over the subhymenial cells multiply and the hymenial portion of the stroma is pushed beyond the stomatal opening. The truncate apices of the conidiophores, thus pushed beyond the stomatal opening, become thick-walled and assume a dark colour (Plate II, Fig. 3) and cut off dark thick-walled cells ultimately expanding into a reniform or hemispherical sclerotium measuring 110-230 × 56-190 μ (Plate II, Fig. 4). The stroma is thus connected with the superficially formed sclerotium by a narrow column of pseudoparenchymatous tissue of elongated cells extending through the stomatal opening (Plate II, Fig. 4). As the sclerotia are superficially formed and not embedded in the tissue they are easily brushed off.

According to Bain[2] Miura has referred to these sclerotia as 'black bodies of unknown nature'. Bain also states that "whether Miura's subepidermal black stroma is formed before or after sporulation is yet to be determined". Studies made by the present authors show that sporulation is not profuse and occurs on the surface of the substomatal stroma at a definite stage of its development. The sporulation period is very brief and is quickly followed by the development of the superficial sclerotia.

Further investigations on the morphology and pathogenicity of the fungus and its cultural characters are in progress.

P. R. MEHTA.
S. K. BOSE.

Botany Section,
Govt. Agricultural College,
Cawnpore,
*December* 29, 1945.

1. Bain, D. C., and C. W. Edgarton, "Two leaf-spot diseases on sorghum and related grasses," *Phytopath.*, 1942, **32**, 1. 2. Bain, D. C. "The sooty stripe disease of sorghum." *Phytopath.*," 1945, **35**, 9. 3. Ridgway, R., 1912, *Colour Standidards and Colour Nomenclature.*

## THE CHROMOSOMES OF *SACCHAROMYCES CEREVISIAE*

THE note on this subject which appeared in the last issue of *Current Science*, embodied the results of an exploratory investigation on the structure of the yeast-cell with particular reference to the chromosomes. There it was indicated that caution was necessary before accepting certain structures which were interpreted as chromosomes by previous workers.[1,2] Further investigation has placed us in a position to state definitely that these bodies are really the centrioles of the organism. While this was in progress, Lindegren's[3] paper suggesting the use of toluidine blue as a specific for the chromosomes of yeast appeared and it has now been possible to demonstrate that there are six pairs of

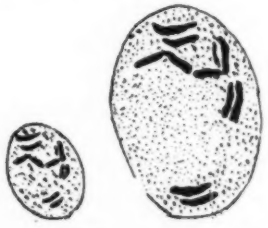


FIG. 1. × 3600 FIG. 1 A. Enlarged

chromosomes in *S. cerevisiæ* (Fig. 1). The nucleus is a compound structure containing the hemispherical centriole intimately attached to the nuclear vacuole. A patch of chromatin is in intimate contact with the centriole. This chromatin which is plastered on to the centriole is responsible for the entire

structure to appear pink after treatment with decolourised basic fuchsin. Advantage has been taken of this fact to work out a differential staining technique in this laboratory. Smears of actively dividing cells are fixed in Lewitsky's mixture for three hours, washed, and subjected to mild acid hydrolysis. The slides are rinsed in distilled water and transferred to decolourised basic fuchsin where they are left for an hour. This treatment causes the centrioles to appear pink, and the slides are next treated with an aqueous solution of toluidine blue. Acid alcohol is used for differentiating and the smears are finally cleared in clove oil, left in xylol for a few minutes after which they are mounted in dilute neutral balsam. Preparations with pink centrioles and dark chromosomes are thus obtained (Fig. 2).

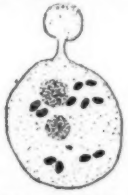


FIG. 2. ×3600

We have thus an improved differential staining technique for the nucleus of yeast by which we can secure differentiation of the centriole from the chromosomes.

In answering the long-disputed question of the nature of yeast chromosomes, we have raised a few fundamental and far-reaching problems. The yeast-cell obviously contains a small quantity of Feulgen-positive chromatin in association with the centriole and Feulgen-negative chromatin in the chromosomes. The latter is in keeping with the early belief that yeast nucleic acid is of the *d*-ribose variety. But then we know that this type of nucleic acid does not polymerise into long thin columns so characteristic of desoxyribose nucleic acid. This being so, one may ask how the nucleic acid is associated with the protein in the chromosomes. If genic action should depend on a zipper-like combination between the long columns of nucleic acid and the protein chains, we have a situation in the yeast chromosomes which demands a new explanation.

Department of Botany,
Central College,
Bangalore, K. V. SRINATH.
*February* 6, 1946.

1. Badian, M., *Bull. Int. Akad. Pol.*, 1937, **B 1**, 1–5. 2. Subramaniam, M. K., and Ranganathan, B., *Curr. Sci.*, 1945, **14**, 3. 3. Lindegren, Carl C., *Mycologia*, 1945, **37**, 6.

## TRANSPORT OF LIVE FISH IN OXYGENATED CONTAINERS

FOR an intensive development of our inland fisheries, an inexpensive method of transport of fry and fingerlings of fish is needed to stock extensively all the impounded waters, streams and rivers. Various kinds of appliances are at present in use in different parts of India such as earthen vessels or *Handis*, which are extensively in use in Bengal for the transport of "spawn" or larvæ, fry and fingerlings; glass containers, used by Mulligan and Majid[1] (1936) for transport of a dozen *Gambusia*, and open-tin containers of various designs used by the Madras Fisheries Department. It is only recently that closed containers with a supply of oxygen, similar to those in use on the Continent and in America, have been introduced in some parts of India[2] (Hamid Khan, 1939).

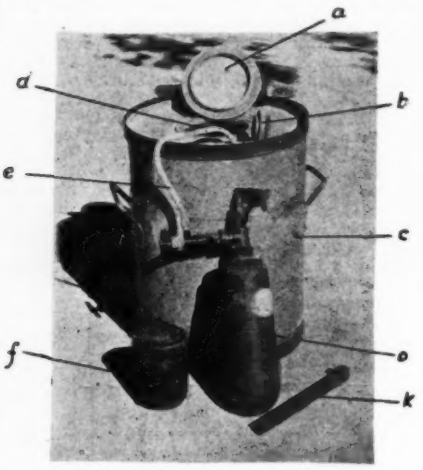
One of the essential features in the transport of live fish is the oxygenation or aeration of the water in which the fish are carried. In open carriers this is done either by change of water or by agitating the water with hand or pumping air into the container by a cycle pump.

The amount of oxygen consumed by fishes of different species varies considerably and the lower limit for dissolved oxygen in water upto which the fish can live is rather difficult to define as even that varies with the species of fish. Experiments conducted on the fry of Rohu (*Labeo rohita* Hamilton) and Mirgal (*Cirrhina mrigala* Hamilton) to determine the amount of oxygen consumed by them in a closed container show that, when the temperature of the water is 75° F., eight fingerlings, four to five inches in length, kept in a closed glass container, containing 8·17 litres of water with 3·316 c.c. per litre of dissolved oxygen, consumed 2·977 c.c. per litre of oxygen in 100 minutes. The fingerlings at the end of the experiment turned upside down, and when removed from the container, only two of them revived when transferred to fresh water. In another experiment, when twelve fingerlings had been kept for 65 minutes, the lethal point was reached when oxygen dissolved in the water was reduced to 0·364 c.c. per litre. Each fingerling had consumed 0·246 c.c. per litre of oxygen in 65 minutes[3] (Hamid Khan, 1940).

*Oxygen container.*—The results of these investigations have been utilized in the transport of carp fingerlings in the Punjab to long distances in closed containers with sufficient supply of oxygen to last for more than 12 hours. The container, measuring 18"× 14", is made of galvanised iron sheet. It is cylindrical in shape and has all its joints soldered air-tight. There are two openings at the top, one 3 inches wide and another 2 inches, both provided with air-tight screw-stoppers (Fig.). The smaller opening leads into an open tube of galvanised iron, 3 to 4 inches in length. The container, when in use, is filled to the brim with water. The fingerlings are introduced and then the larger stopper is closed tightly. The oxygen is then blown through the smaller opening. Water is displaced upto the length of the inner tube by the pressure of the oxygen. The smaller opening is then tightly screwed on. The fish thus have an atmosphere of oxygen upto 3 or 4 inches. The oxygen gets dissolved in the water when the container is in transit by the jolting movements of the train or the lorry.

The capacity of the container to hold the fry or the fingerlings varies with the distance to

be travelled, the duration of the journey, the temperature of the water and the amount of oxygen dissolved in it. For a distance, which




Oxygen fish-container (*c*) with oxygen cylinder (*o*).
*a* = Screw stopper of larger opening.
*b* = Screw stopper of smaller opening.
*d* = Large opening
*e* = Rubber tubing leading into smaller opening through which oxygen is blown.
*f* = Cover of oxygen cylinder.
*k* = Key to open-srcew stopper (*b*).

can be covered within 12 hours, in winter, each container can hold 200 fry of 1 to 2 inches length, 100 fingerlings of 3 to 4 inches in length, or 30 to 50 yearlings of 5 to 8 inches in length.

The average mortality of fingerlings and yearlings during transit has so far ranged from 2 to 4 per cent.

The cost of the container in pre-war days was Rs. 16 each, and even with rough handling it lasted for more than ten years. The oxygen is available at a cost of one or two annas per cubic foot, which is sufficient to fill two carriers. No special attendant is needed and no change of water is required *en route*. The introduction of these carriers for transport of fingerlings in the Punjab has reduced the cost of transport to more than half of what was previously incurred on transport in open carriers. The oxygen containers have been in use in the Punjab for the last ten years and have given quite satisfactory results.

Warden of Fisheries,
Punjab, Lahore, HAMID KHAN.
*December* 12, 1945.

1. Mulligan, H. W., and Majid, A., *Rec. Malaria Surv. India*, 1930, **6**, **4**, 537–47. 2. Hamid Khan, *Seasonal Notes, Punjab Agricultural College, Lyallpur*. 1939, **18A**, 2, 41–42. 3. —, *Ind. Journ. Vet. Sci. and Anim. Husb.*, 1940, **14**, 372–81.

## A NEW SPECIES OF GENUS *TRICHURIS* FROM CATTLE AND BUFFALOES

THE species described in the paper was collected mixed with *Trichuris discolor* from Mukteswar, Izatnagar and Sialkot on five occasions. More than fifty cattle and buffaloes were examined for this purpose alone in the localities mentioned above. Fæcal examination of dairy animals at Izatnagar revealed *trichurids* to be absent in adult animals but calves of about one to one and a half years of age always passed eggs in their fæces. It is possible that age plays an important part in infestations with *trichurids* of cattle and buffaloes. The number of parasites in each collection varies from fifteen to forty and only include the species under description and *T. discolor*.

*Trichuris indica* sp. n.

*Male*.—Length of anterior part 34-38 mm.; length of posterior part 11-12 mm.; and maximum breadth of the parasite 0·3-0·42 mm.

The spicule (Fig. 1) resembles in general that of *T. globulosa* in being robust and pos-

FIG. 1. *T. indica* ; posterior end.

sessing 'flares' at the anterior end. It tapers down posteriorly in a more or less sharp point unlike the hyaline tip described for *T. globulosa* by the author (paper in press). In length the spicule measures 3·4-4 mm. and breadth in about the middle is 0·022-0·285 mm.

The posterior swollen part of the sheath is not fully everted in any of the specimens. The length of the tubular proximal part is 1·1-1·3 mm. and the spines on it measure 0·0075-0·009 mm. The spines on the distal swelling of the sheath measure 0·018-0·020 mm.

There is a conical papilla on either side of the posterior end of the body (Fig. 1).

The testis starts behind the beginning of the cloaca, is straight in the region of the ejaculatory duct but is convoluted in that of the vas deferens. The length of vas deferens is from 3·5-5 mm.; that of the ejaculatory duct from 2·65-3·7 mm.; and that of cloaca 2·23-2·7 mm. with the spicular tube joining it 1·52-1·9 mm. from the posterior end.

*Female*.—Length of anterior part is 36-42 mm., while that of posterior is 8·5-11 mm.

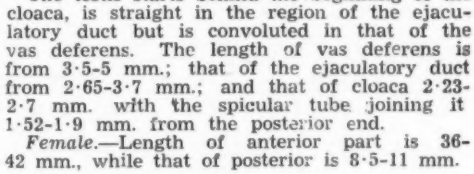


FIG. 2. *T. indica* ; vagina.

The vagina has two proximal curves communicating with a dilatation posteriorly through a narrow passage of uniform calibre measuring about 0·3 mm. long. The muscular prolongation (*a*) divides the proximal two cavities, the first cavity being twice as capacious as the second one. The cavities are lined by spines. The eggs including opercula measure 0·068-0·072 mm. long and 0·034-0·375 mm. broad.

Host.—*Bos indicus* and *Bos bubalis*.

Location.—Cæcum.

Locality.—Sialkot (Punjab), Izatnagar and Mukteswar-Kumaon (U.P.).

*Specific diagnosis.*—Trichurids having spicules 3-4·4 mm. long and 0·022-0·0225 mm. broad and ending in a more or less sharp point. Body carrying a papilla on either side of its posterior part with a sheath having spines which on the distal swelling are more than double the size of those on the proximal part.

Vagina having two curves in its beginning, the first being twice as large as the second one. The curves being followed by a passage of uniform calibre and which expands to form a dilatation posteriorly. Eggs measure 0·068-0·072 mm. long and 0·034-0·0375 mm. broad.

Cæcum, cattle and buffaloes, Sialkot (Punjab), Izatnagar and Mukteswar-Kumaon (U.P.).

*Discussion.*—This species differs from all other epecies of the genus *Trichuris*, with the exception of *T. globulosa*, by its possessing larger spines on its posterior bulb of the sheath than on its anterior tubular part. It differs from *T. globulosa* by the possession of a papilla on either side of the posterior end, the spicule ending posteriorly in a more or less sharp point and not a hyaline tip preceded by sabre-shaped part. The vas deferens and ejaculatory duct in the author's species are about half the size of those of *T. globulosa*. In *T. globulosa* there are angular beds in the proximal part of vagina and the neck following the beds immediately expands into a dilatation. In the author's species angular beds and neck are absent. The fact that the collections were made from different localities at different parts of the year and all the individuals in all the collections present constant features, is significant.

Department of Food,
Government of India,
New Delhi, M. M. SARWAR.
*October* 1, 1945.

1. Baylis, H. A., "Three Notes on Parasitic Nematodes," *Ann. Mag. Nat. Hist. Ser.*, 1932, No. 10, **10**, 497-502. 2. Ortlepp, R. J., "Whipworms from South African Ruminants," *Ond. Jl. Vet. Sci. Anim. Ind.*, Union of South Africa, 1937, **9**, No. 1. 91-100.

## PHYSIOLOGY OF EXCRETION IN EARTHWORMS

IN an important memoir on the Physiology of Excretion in Earthworms (*Quarterly Journal of Microscopical Science*, Oxford, Vol. 85, Pt. IV, September 1945), Prof. K. N. Bahl of the University of Lucknow gives a very interesting and instructive account of his experiments and observations. He finds that the earthworm voids its excretory products as ammonia and urea and that there is no trace of uric acid in its urine. Ammonia and urea are first formed in the body-wall and gut-wall and are passed on to the blood and cœlomic fluid, whence they are eliminated by the nephridia. In fact, ammonia and urea have been estimated for the first time in the blood, cœlomic fluid and urine of an earthworm. Since the blood contains excretory products, the current view that blood is merely a carrier of oxygen has been proved to be untenable. In order to determine the role of the nephridia in osmotic regulation, the author has carefully estimated the osmotic pressure and the protein and chloride contents of blood, cœlomic fluid and urine, and has come to the conclusion that an earthworm, when submerged in water, can live like a fresh-water animal when both its gut and nephridia act as osmo-regulatory organs; but in the soil the earthworm lives like a terrestrial animal and the osmo-regulatory function adequately discharged by its nephridia alone, which reabsorb proteins and chlorides and conserve water. The mechanism of excretion has been clearly analysed into processes of filtration, reabsorption and chemical transformation. The significance of the phagocytic section of the nephridium has baffled many a previous worker, but Prof. Bahl, by making a spectroscopical examination of a solution of brownish excretory granules in pyridine, has conclusively proved that the colouring matter of these granules is the blood-pigment "hæmochromogen", and that the phagocytic section is really a "storage kidney" storing the destructive products of blood.

We might only add that not only has he obtained valuable results but that the technique he has devised for collecting adequate quantities of blood and urine is equally remarkable, as it was this difficulty which had so far made analyses of these fluids impossible.

S. L. HORA.

# REVIEWS

**Photosynthesis and Related Processes.** By Eugene I. Robinowitch. Vol. I. (Interscience Publishers Inc., New York, N.Y.), 1945. Pp. 559. Price 8.50 dollars.

The author is a well-known worker in the field of Photochemistry and is now a member of the Solar Energy Research Project Committee of the Massachusetts Institute of Technology. A comprehensive treatise on Photosynthesis by an expert of his standing will remove a long-felt want. The present volume is divided into two parts.—I. The Chemistry of Photosynthesis and Related Processes and II. The Structure and Chemistry of the Photosynthetic Apparatus. In the treatment of the subject, much of the older work which are of doubtful value has been omitted but those that are of historical importance and enduring influence have been discussed in detail. All recent literature up to 1943 have been incorporated in this book with a critical insight, and the author has not hesitated to express his views on the merits and defects of the experimental technique, the conclusions, and hypotheses developed by research workers now investigating this fascinating but almost baffling problem. It is estimated that $20 \times 10^{10}$ tons of carbon are annually fixed on earth by photosynthesis. Hence the importance of an accurate knowledge of the mechanism of this process is obvious. We are yet, however, far from the goal, i.e., fixation of carbon outside the living cell with the aid of solar radiation and plant pigments.

Observations made by Rubens and co-workers, using for photosynthesis, carbon dioxide and water containing radioactive carbon and heavy oxygen, have proved beyond doubt that the oxygen evolved in photosynthesis comes from water alone and that carbon dioxide is incorporated in the dark into a large molecule of the plant material probably forming a carboxyl group. Such definite conclusions are, however, rare. But, as the author says, "during the last twenty years, some important new avenues of approach to the study of photosynthesis have been opened. Mention may be made for example, of oxygen liberation by isolated chloroplasts; of the broader view of the chemistry of photosynthesis by the study of bacteria; of the discovery of the possibility of changing the chemical course of photosynthesis in certain algæ by substituting new substrates for carbon dioxide and water". The use of flashing light, new experimental procedures for rate measurements by sensitive physical methods, new knowledge of the structure of the photosynthetic apparatus, detailed chemical examination of the chloroplasts, extensive application of the methods of enzymechemistry—all these promise rapid progress in this field. The author has done well in emphasising these newer trends in the study of photosynthesis and has produced a book which will be a standard work of reference for anyone interested in the subject.

The reviewer recalls with pleasure the interesting discussion he had with Professors Franck and Gaffron in Chicago a year ago on these new developments. The book bears the impress of the spell which these two path-finding investigators have also cast on the author.

J. C. GHOSH.

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**Dynamic Meteorology.** By Jorgen Holmbe, George E. Forsythe and William Gustin, Department of Meteorology, University of California at Los Angeles. (John Wiley and Sons Inc., New York; Chapman and Hall, Ltd., London.) Price 4.50 dollars.

Here is a book which every student and professor of meteorology should welcome. It is an ideal and up-to-date text-book for the advanced student. Written in the traditions of the Norwegian School it reveals how thoroughly the weather forecaster was trained in the U.S.A. during the war. In this volume the authors deal with the major aspects of "Dynamic Meteorology". Naturally, topics like instrumental technique, descriptive aspects of synoptic meteorology, atmospheric turbulence and radiative phenomena are omitted. The treatment of the subjects actually dealt with is condensed and logical. By following an admirable system of cross-references repetitions are completely avoided. The book is self-contained and by the use of vector methods the theoretical treatment of atmospheric motion and circulation is handled with brevity and elegance.

The book is divided into twelve chapters. The first is devoted to dimensions and units. The next two deal with the thermodynamics of dry and moist air respectively. After discussing hydrostatic equilibrium in the earth's atmosphere and its stability (chapters 4 and 5) the authors proceed to discuss the problems of atmospheric circulation in the remaining seven chapters. In Chapter 10 the authors have included their discussion of the theory of cyclones which appeared in the *Journal of Meteorology* recently (1944).

The book deserves a place by the side of other recent treatises on meteorology like *Physical and Dynamical Meteorology*, by D. Brunt; *Weather Analysis and Forecasting*, by S. Petterson; and *Dynamic Meteorology*, by B. Haurwitz. The authors deserve to be congratulated for bringing out a volume which is sure to be a companion to every serious student of theoretical meteorology. We recommend it to all progressive Universities in India which have introduced or intend to introduce an advanced course in Meteorology for the M.Sc. degree.

L. A. R.

**The Organic Chemistry of Sulphur**: *Tetracovalent Sulfur Compounds*. By Chester Merle Suter. (New York: John Wiley & Sons, Inc., London; London: Chapman & Hall, Ltd.), 1944. Pp. v + 858. $10.00.

We now look to the U.S.A. for those comprehensive, if uncritical, reviews of literature, *Handbucher, Enzyklopadien*, once a product of German assidutiy. The organic chemistry of sulfur has a copious but scattered literature, which has been very little collated, and a new volume on the subject cannot fail to be of interest.

The book under review deals, as its sub-title indicates, only with those "compounds which in a broad sense are derivatives of sulfuric acid". Its scope may be indicated by quoting the seven chapter headings: "I. Esters of Sulfuric Acid, II. Aliphatic Sulfonic Acids, III. The Preparation of Aromatic Sulfonic Acids, IV. The Properties and Reactions of Aromatic Sulfonic Acids, V. Derivatives of Aromatic Sulfonic Acids—1. Sulfonyl Halides, Esters and Anhydrides, VI. Derivatives of Aromatic Sulfonic Acids—2. Sulfonamides and Related Compounds, VII. Sulfones." This ground has been previously covered, less exhaustively, by J. Halberkann and F. Fretwurst in a monograph *Sulfonieren* (published in 1929 as a part of Abderhalden's *Handbuch der biologischen Arbeitsmethoden*—Abt. 1, Chemische Methoden, Teil 2, 2 Halfte, heft 3, s. 1969-2104), a work not easy of access and to which no reference appears in the present volume. The bibliographies of the seven chapters are extensive. A small "test check" of references was possible, as the reviewer happened to have prepared some time ago a reasonably complete bibliography relating to Sulphonyl Halides, Esters and Anhydrides, and he is able to add nothing essential to the author's survey.

Due attention is paid to those products which have practical applications, though the treatment of sulphonated oils is brief and Burton and Robertson's book *Sulfonated Oils* (1939) is not mentioned. Chapter VI includes good accounts of saccharin, sulphohaloamides and sulphanilamide with a useful discussion of methods of estimation.

A more complete account of sulphones could hardly be found elsewhere and some curious recent observations are duly noted, including that of the occurrence of dimethyl-sulphone in cattle blood and adrenal glands (1940). The triboluminescence of sulphobenzide might have been mentioned; this appears to be a property of only one of the allotropic forms described by Bogert in 1936 and is worth investigation.

Only a few unimportant inaccuracies have been noticed, such as errors in proper names. The index—mostly to compounds mentioned in the text—is constructed on the *Chemical Abstracts* method; occasional inconsistencies occur, mesitylenesulphonyl chloride appearing also as trimethylbenzenesulphonyl chloride, p-anisidine-sulphonic acid as 5-amino-2-methoxybenzenesulphonic acid, whilst these duplications do not appear in other cases. These are, however, small points and the labour of the indexer must have been so considerable that the reviewer hesitates to suggest that German assiduity would have proved a *Namen-vezeichniss* also!

In his short preface, the author disarmingly suggests that the preparation of a second volume to cover "the remainder of sulfur chemistry" will depend on "the interest of organic chemists in this type of monograph and other demands on the author's time". The interest of organic chemists need not be in doubt; the present volume must find its place in all adequate chemical reference libraries. The coming of peace may have removed the other obstacle by reducing alternative demands on the author's time. It may be suggested, however, that a single volume will hardly suffice to deal with the remainder of the subject on the scale of the present one; the heterocyclic compounds of sulphur will almost certainly find themselves relegated to a third volume.

In the meantime, we have Connor's useful survey of organic sulphur compounds in Volume II of the second edition of H. Gilman's *Organic Chemistry*, and we are promised an A.C.S. monograph by E. E. Reid. What is needed, besides the undoubtedly valuable work of the collator or compiler, is a critical account of the subject in relation to modern theories of organic chemistry, on the lines of Sidgwick's classic treatment of the organic compounds of nitrogen.

Wokingham, REGINALD CHILD.
*September* 16, 1945.

**Plants and Plant Sciences in Latin America.** Edited by Dr. Frans Verdoorn, Ph.D. (The Chronica Botanica Co., Waltham, Mass.; Messrs. Macmillan and Co., Ltd., Calcutta), 1945. Pp. xi + 384, with 83 plates and text-illustrations. Price $6.00.

It is unnecessary to stress the need for greater international collaboration in the study of plant sciences. A constructive programme towards this end, however, had not been seriously thought of till now. As a help in this direction, the *Chronica Botanica* authorities have recently published an account of the vegetation and natural resources of Latin America together with a survey of the present condition and the future possibilities of a number of branches of plant sciences in that region, whose problems are not merely of local but of international importance.

Dr. Frans Verdoorn himself contributes an introductory essay entitled, "The Plant Scientist in the World's Turmoils", in which he has dwelt upon the importance of an international understanding of plant sciences and how best this can be done. The book contains contributions from nearly 100 authoritative writers, the contributions dealing with each politically delimited localities of Latin America. Most of the contributions are written up in English but about 18 are in other languages as Spanish, French and Portuguese. The entire book is divided into two parts. The first part contains primarily articles not previously published whereas the second part contains reprints of articles already published in the pages of *Chronica Botanica*.

The first part opens with the chapter, "Problems of Tropical American Agriculture",

After devoting the next three chapters for phytogeographic sketch, principal economic plants, and historical sketch, which are of general botanical interest, regional descriptions follow. About 25 politically delimited regions of Latin America have been treated by experts and each individual exposition is enclopædic. Further, there are about 23 titles dealing with botanical subjects of general interest concerning Latin America but on a regional basis. Of these, "Hevea Rubber Culture in Latin America; Problems and Procedures" by Dr. R. D. Rands, "Notes on Cinchona Culture" by Dr. W. Pennock, "Aims, Scope and Future of Research on Fibre Plants in Latin America" by Dr. B. B. Robinson, deserve careful study by every botanist. Of particular interest is the special supplement, "Plant Breeding, Genetics and Cytology in Latin America" by Dr. C. A. Krug. To an Indian botanist this is specially welcome, as he is also confronted with many pressing problems concerning the improvement of Coffee, Cinchona, Rubber, etc.

A large portion of the second part is again devoted to about 15 regional descriptions. Though many of the regions treated in this part overlap those in the first, information contained is by no means a repetition. A list of "Travel Books of Botanical Interest", "List of Collectors in the West Indies, Central America and South America" and the special supplement, "Plant Institutions, Stations, Museums, Gardens, Societies and Commissions in Central and South Americas" which is comprehensive and up to date has come as a very handy tool to every naturalist, collector or researcher, who is anxious to contact his co-workers.

The illustrations for the book have in many cases been selected from classical publications; and a careful study of some of them rouses curiosity in the reader as to the history of plant sciences. Of particular interest are the end-pages illustrating the vegetation of Latin America picturesquely. The size and get-up of the book conform to the familiar style of the *Chronica Botanica* series. While recording our sincere admiration for the work of the authorities, we would also express the hope that through their efforts similar compendiums dealing with the plants and plant sciences of other countries may soon become available to students of botany.

B. G. L. S.

**Fungicides and Their Action**—*Annales Cryptogamici et Phytopathologici*, Vol. II. By James G. Horsfall. (Messrs. Chronica Botanica Co., Waltham, Mass., U.S.A.), 1945. Pp. 239. Price $5.00.

Yet another excellent publication has appeared in the new series of *Annales Cryptogamici et Phytopathologici*. Large number of books on Fungicides have been written in the past, but the present one is a departure from the normal in that it very ably combines fundamental knowledge with the applied aspect of the problem. Astounding progress has been made during this century in the field of fungicides, particularly on the organic side. In all these studies, intensive and extensive, statistical interpretation of experimental data accruing out of each experiment has put the subject on a sound and sure footing. What we needed at the present moment was a critical review of the position to-day as far as "Fungicides and their Action" were concerned. This task has been most admirably accomplished by Dr. Horsfall, who, for over fifteen years, has built up a sound school of "Plant Chemotherapy."

The chapters of laboratory assay; some problems of data assessment; principles of chemical protection; coverage of single and multiple surfaces; artificial immunization and chemotherapy; action of copper, sulphur; action of organic nitrogen compounds, etc., have been very well written. The reviewer was particularly attracted by the chapter on "Artificial immunization and chemotherapy". This chapter on chemotherapy is written, as in the case of other chapters, with up-to-date literature on the subject. The work in this line by the discovery of antidoting the toxin of Dutch elm disease by using diaminoazobenzene dihydrochloride, 8-hydroxy-quinoline sulphate and malachite green, has opened out a new avenue of research. Further, other promising chemicals in this line are mentioned, *viz.*, urea, hydroquinone and many others where their basic nitrogen might have been responsible in part for the antidoting action. In this connection, ascorbic acid, a substance with strong reducing properties, was injected into eggplants sick with the wilt fungus *Verticillium albo-atrum*. The wilted plants showed recovery. Perhaps, even more promising than the above examples is the work on inactivation *in vivo* of the virus disease known as X-disease of peach. This again was done by urea, calcium 8-hydroxyquinolate, etc. All this suggests that the instance quoted here of *in vivo* inactivation of plant virus is due to either oxidising or reducing of the toxin to an innocuous level.

The other chapter written very ably is the one on "Action of organic nitrogen compounds". It would be impracticable to go into the details of this chapter within the course of this review. On the whole, this well-got-up publication would attract considerable attention from both pathologists and organic chemists who work on this most fascinating field of fungicides and their action. The reviewer unreservedly recommends this volume to the researchers and students of botany or phytopathology who wish to have the latest and most trenchant views on the subject of fungicides.

T. S. SADASIVAN.

**A Changing Social Structure** (being a collection data submitted to *ad hoc* Committee appointed by the Conference of Trusts), 1945. By Sapur F. Desai, Joint-Secretary, Parsi Panchayat, Bombay. Pp. 59.

This brochure has been prepared from the information collected by Mr. Desai for submission to the *ad hoc Committee* appointed by the conference of charity trust to deliberate on different problems of the Parsis. It deals with such problems as health, nutrition, unemployment,, education, housing and organisation of the Parsis who are one of the most important

communities in the Province of Bombay. Much of the brochure is naturally taken up with tables which in many cases cover statistics for the forty odd years of the present century. The author has no doubt presented the available data objectively, as far as possible and nowhere indulged in wide generalisation. The study of this privileged and gifted community can, however, hardly give an adequate idea of the problems facing the entire community. For example, the low birth-rate and death-rate noticeable among the Bombay Parsis in the last decade could hardly be taken as an index of the population trends even in Bombay city as a whole and conclusion based thereon. The entire data collected for the Parsi community can, however, be useful in determining the tendencies of the more advanced communities and in suggesting remedies for the more unhealthy trends. The social structure of the Parsi community has undergone gradual changes in the direction of progressive urbanisation with all that it involves. The tables prepared show how the numbers of unmarried persons have gone up four times during the last fifty years (1881-1931) while the number, of married people has gone down by half during the last twenty years. In education, Mr. Desai notices the trend towards Science and Technical Courses while Agriculture, Law, Engineering, Medicine and Teaching seem to be losing charm for the Parsi boys. In regard to health and nutrition, the general standard of the Parsi community is much higher than other classes of population. The huge amounts spent by the Parsi community on charity in the shape of doles for the poor members of the community and in providing cheap accommodation for poor families in Bombay are unequalled by any other class of the population. The trustees of the Parsi Panchayat also run an unemployment bureau which is able to help most of the persons capable of being employed. On the whole Mr. Desai has given us good statistical information about the Parsi community although one would have wished him to have given a more extensive analysis of the "changing social structure" and ways and means by which the undesirable tendencies could be checkmated.

**The Effect of Activity on the Latent Period of Muscular Contraction.** By Alexander Sandow. (Published in the *Annals of the New York Academy of Sciences*, Volume XLVI, Arl. 3, pp. 153-154.)

The minute mechanical changes occurring during the latent period of muscular contraction have been recorded by a highly sensitive device consisting of a piezo-electric, cathode-ray oscillographic technique which, with great reliability, permits determining the activity induced latency time differences of the order of several 0·1 ms. and length differences of about 0·05 $\mu$. The results obtained have been highly interesting. The effect of activity on the various variables occurring during the latent period has been obtained. These changes are correlated in some detail with activity induced pH changes, studied in other investigations. This correlation and several other implications of the data are shown to be confirmatory evidence for a previously advanced hypothesis that the latency relaxation is a mechanical sign of a tension-induction process involving mechano-chemical coupling of myosin and adenosine triphosphate in the form of an enzyme-substrate combination, during the existence of which the myosin is energised and activated for contraction.

I may here point out that in smooth muscle, it is quite common to see an initial relaxation preceding a contraction, when the muscle is stimulated with alternating current, potassium, adrenaline, nitrate, thiocyanate, etc., as published in my papers in the *Journal of Physiology* and the *Proceedings of the Indian Academy of Sciences*. This initial relaxation decreases with increase of pH, as in skeletal muscle, so that it appears that the two are related. I have postulated that it is due to release of calcium. INDERJIT SINGH.

## CHROMOSOMES AND EVOLUTION*

SYNTHESIS should follow analysis and nowhere is a synthesis more difficult than in Cytogenetics. To get the correct perspective the whole field has to be viewed from the evolutionary standpoint. Though chromosomes form the common "mechanical and physiological denominator" of plants and animals, evolution has proceeded in entirely different directions.

It is said that the majority of angiosperms could be traced to polyploid ancestors. Duplications of either individual chromosomes or of whole sets, thus appear to have played a major role in the evolution of new species in plants. Polyploidy is so rare in animals that it appears very doubtful whether they have any role at all in speciation. "It was pointed out by Muller (1925) that in bisexual organisms polyploidy will inevitably upset the sex-chromosome mechanism, since it automatically abolishes heterogamety. Thus a tetraploid of an originally XY:XX form will have the composition XXYY:XXXX and nearly all the gametes of the originally heterogametic sex will be XY (due to the two X's and the two Y's forming separate bivalents at meiosis). So that even if a tetraploid male and female meet and pair they would stand no chance of starting a tetraploid race" (p. 181).

And again it is very doubtful whether the well-known type of genetic system of higher plants, allopolyploidy, exists in animals at all. All the metazoan polyploids appear to be autopolyploids. "The distinction between auto- and allopolyploidy is not, of course, an absolute one, and if a doubling of the chromosome number followed on crossing between the two

* *Animal Cytology and Evolution* By M. J. D. White. (Cambridge University Press), 1945. Pp. 375 + viii. price 36 *sh.* Net.

sub-species or strains of the same species it would be difficult to decide whether the resulting form should be called an auto- or an allopolyploid. If any allopolyploids exist in animals they are probably borderline cases of this kind" (p. 305).

Under the circumstances we find chromosome studies playing an important role in plant breeding. Since hybridisation and polyploidy have played a major role in evolution of plants, chromosome studies have become essential for any correct appreciation of the phylogeny of especially the economically important plants.

Thus while animal cytology is little used by taxonomists and others, it is work on Drosophila which has given us our modern genetical conceptions. The rapid strides in the cytology and genetics of Drosophila has made "Drosophily" a separate branch of biology. Unconsciously a barrier has arisen between students of Drosophila and cytologists and geneticists interested in other groups of organisms. "Thus the former are frequently ignorant of not an inconsiderable amount of cytological work which has been carried out on Orthoptera, Vertebrates, etc.; while conversely, those who have worked on the cytology of grasshoppers or mammals, are often woefully ignorant of Drosophila genetics".

It is doubtful whether at the present day any single person could present a balanced synthesis of our knowledge of the genetical and evolutionary cytology of animals and plants. Dr. White, therefore, deals in the book under review only with the evolution of animal chromosomes mainly with a view to "close up the cleavage between Drosophila workers and general cytologists".

The phenomenal advance in Cytogenetics during the past one decade is mainly due to the rediscovery of the salivary chromosomes in 1933. Their use in genetic investigations and analysis of wild populations has resulted in a reorientation of the older concepts. "Once again as in the time of Weismann, the chromosomes are coming to occupy the central place in physiological and evolutionary thought, only this time we know vastly more about their detailed structure and genetical behaviour in a great variety of animals and plants. By studying salivary gland chromosomes it is possible to make direct comparisons between the gene sequences of different individuals and species with an ease and precision previously undreamed of. It is now more than ever apparent that it is quite impossible to analyse the mechanism of evolution without taking into consideration structural rearrangements of chromosome parts" (p. 3).

As a result of intensive investigations the chromosome sets are assuming a new significance. "The newer conception of the chromosome as an organized body whose parts stand in definite functional relationship to one another has replaced the crude and atomistic idea of a row of entirely independent chromomeres like beads on a thread. The view that changes in chromosome number can take place by simple 'fragmentation' and 'fusion' died when it was realized that each chromosome possesses a centromere, and that centromeres do not arise *de novo* but only from pre-existing centromeres (Navashin, 1932). Thereafter it was clear that an increase in chromosome number must involve duplication of a centromere together with a region (large or small) around it; while a decrease in chromosome number must involve permanent loss of a region containing a centromere. Thus both increases and decreases lead to concomitant changes in the total amount of genetic material, and must hence be expected to produce genetical changes, quite apart from the position-effect. Whether these laws apply to groups like the Heteroptera and Homoptera, where centromeres cannot be detected cytologically is still uncertain; but there can be no doubt that they apply in the vast majority of organisms" (p. 152).

It is being increasingly realized that the function of a gene depends on its position in the gene sequence and that any alteration of its position alters also its properties. "Although in the present state of our knowledge, it is difficult to make general statements about the rather diverse phenomena included in the term position effects, it is clear that they are all expressions of the continuity of the chromosome. In the early days of Drosophila genetics the emphasis was entirely on discontinuity (effects of single genes conceived of as discrete units). More recently certain writers such as Goldschmidt have swung to the opposite extreme, thinking that all genetical phenomena should be regarded as expressions of a continuous molecular pattern in the chromosomes and that all mutations are nothing but position effects resulting from minute structural rearrangements. The truth, for Drosophila at any rate, would appear to lie somewhere between these extreme view-points. For, maize, on the other hand, the older view-point seems to be almost completely true, since no undoubted position effects are known, in spite of the fact that a number of structural rearrangements have been studied. Perhaps, the 'internodes' between the genes are longer or at any rate more completely devoid of genetic properties than they are in Drosophila (pp. 310-11).

The discovery that structural rearrangements could be induced by diverse agencies such as temperature shocks, chemicals and irradiation is now being increasingly exploited. Since the breakages produced by the above diverse agencies appear to be similar, planned experiments have been carried out with a view to analyse the changes in gene sequence which might have occurred in the course of evolution.

A phenomenon comparable to duplication of chromosomes came to light as a result of investigations on salivary chromosomes. These are the *repeats*—duplications of small segments of chromosomes. The evolutionary significance of these repeats seem to be considerable. It appears that "the repeated regions represent an important kind of 'raw material' for future evolution, and that the evolutionary potentialities of an organism depend, in the long run, partly on the extent and kind of repeats in its chromosomes. This is, of course, mere speculation—but it is in accordance with

what is known of the genetics of polyploids in plants (Haldane, 1930)" (p. 48).

Just as segments get repeated, segments of chromosomes may get deleted also. Though in the main deficiencies reduce viability it appears as if some genes could be deleted with impunity. "The longest deficiencies known to be viable in the heterozygote include about 50 bands. In very rare instances flies homozygous for a small deficiency may be viable (Bridges, 1938; Panshin, 1938)" (p. 49).

It is probable that there may be considerable differences of opinion regarding some of the speculations presented in the body of the book such as that "in the $X_1X_2Y$ group the translocation probably *took place at least as long ago as the Miocene* and possibly earlier. The large number of $X_1X_2Y$ species in Africa and Asia suggests that *it took place somewhere in the Old World*", etc., etc. (p. 254). These are merely bold guesses which every author has the right probably to indulge in!!

One wonders whether the name of the hermaphrodite polychæte mentioned on page 288 is spelt properly!

The species problem still remain elusive. This is not surprising since the extensive studies on Drosophila on the above problem from all conceivable angles brought home the fact that it is very difficult to clearly distinguish species from sub-species! We have yet to discover the relative roles of the various agents in speciation.

The author has to be congratulated for his excellent account.

M. K. SUBRAMANIAM.

## SCIENCE NOTES AND NEWS

### THE INDIAN SCHOOL OF MINES, DHANBAD

Big demands for admission into the Indian School of Mines, Dhanbad, and for the services of qualified Coal Mine Managers are recorded by the annual report of the Working of the Indian School of Mines, Dhanbad, for 1944-45. 2,518 Candidates sought admission into the School in 1945 as against 2,183 in 1944 and 1,335 in 1943. Of these, 394 were selected for the entrance examination after which 43 were enrolled as students for 1945-46.

Students of the Indian School of Mines during the session 1944-45 fared well, as usual, in their examinations. Six out of the ten successful candidates in the examination for the first-class Coal Mine Manager's Certificates were I.S.M. students, and the first three places were also secured by them. Out of 26 who came out successful securing second-class Coal Mine Manager's Certificates, 21 were from the I.S.M. and ranks 1 to 14 also went to them. The I.S.M. got 15 out of 59 passes in the Mine Surveyor's Certificate Examination. Only one failed out of the 23 candidates sent up to the examination for the diploma of Associateship in Mining Engineering and in Geology, while all the 20 candidates who appeared for the examinations for Certificates in Coal Mining and in Geology passed.

Research work was carried on in the washability and grading of coal. X-ray examination of Indian coals was continued and three original papers on geological subjects were contributed by the staff. The total number of scholarships held by students during this year was 71.

### 1851 EXHIBITION RESEARCH SCHOLARSHIPS

The Royal Commissioners for the London Exhibition of 1851 have offered to award annually two Science Research Scholarships of the value of £350 per annum for students from Indian Universities or Institutions having post-graduate departments of science. The scholarships are post-graduate and are intended to enable the selected students, who have already completed a full University course and whose record indicates a high promise of capacity for advancing science, to devote themselves to research work for two years.

Provincial Governments and Local Administrations have been asked to invite recommendations from Universities and Institutions for the scholarships to be awarded in 1946 and to forward them to the Government of India by March 31, 1946.

Candidates must be British subjects, or British protected persons, being subjects of Indian States, and should be below the age of twenty-six years on May 1, 1946. Applications of candidates above the prescribed age will be considered only under very special circumstances. A period of War Service will be regarded as 'special circumstances'.

No application from a student residing in India or abroad will be considered unless it is recommended by the authorities of a University or Institution in India.

*University of Madras, Notification.*—Applications are invited for the appointment of Director (Professor) of the Research Laboratory in Zoology on a salary of Rs. 750-50-1,000.

Applicants should be graduates of Indian or British Universities with high academic qualification and should have sufficient experience of research work. A knowledge of Marine Zoology will be an additional qualification. Last date of application: 1st June 1946.

Applications are invited for the post of a Lecturer in Statistics on a salary of Rs. 210 per month in the grade of Rs. 210-15-300.

Applicants must possess a First or Second Class Honours Degree in Science, Mathematics, or Economics with post-graduate qualification in Statistics, if this subject did not form part of the Degree course, and have research experience. A research degree in Statistics will be an additional qualification. Last date of application: 15th March 1946.

*Fellowships for Research in Physics and Chemistry.*—With a view to encouraging re-

search in Chemistry and Physics, the Imperial Chemical Industries, Ltd., have established Fellowships in the University of London. The Fellowships will be awarded for original research in Chemistry, Physics, Engineering, Metallurgy, Pharmacology and Chemotherapy.

The Fellowships are open to persons of either sex. They are normally of the value of £600 a year and will be tenable for a period of three years in the first instance. A Fellow will have to take a limited part in the teaching of the Department in which he works.

This year the Fellowships will be tenable from October 1946 but applications from candidates now on National Service who cannot take up appointment to the Fellowship until later will also be considered. Detailed Regulations and Application Forms can be obtained from the Academic Registrar, University of London, at the Senate House, London, W.C. 1. The last date by which applications should reach at this address is April 30, 1946.

*University of Madras Endowment Lectures*, 1946-47.—The Syndicate will proceed shortly to select persons to deliver lectures under the following endowments for the year 1946-47. Applications for lectureships will be received by the undersigned not later than the 1st March 1946. Applicants are requested to give full particulars regarding their qualifications and the subject selected by them for the lectures. The lectures are to be delivered before January 1947. Separate application should be submitted for each lectureship.

The principal terms and conditions of award are given below :—

(1) *The Maharaja of Travancore Curzon Lectureships* : Three lecturesnips of the value of Rs. 250 each, relating to (*a*) Medicine (Clinical), (*b*) Engineering and (*c*) Agriculture. Applicants should be graduates of the University.

(2) *The Sir Subrahmanya Ayyar Lectureship* : Value Rs. 250. The lectures should be on a subject connected with Natural Science. Applicants should be graduates of the University.

(3) *The Gokhale Lectureship*: Value Rs. 250. The lectures should be on a subject connected with Indian Economics. Applicants should be graduates of the University.

(4) *The Sankara Parvathi Lectureship* : Value Rs. 250. The lectures should be on a subject connected with Ancient South Indian History. Applicants should be graduates of the University.

(5) *The Sir William Meyer Lectureship* : Value Rs. 1,500. A course of not less than six lectures should be delivered on a subject in History. Half the remuneration will be paid after the delivery of the lectures and the other half after the publication of the lectures.

(6) *The Principal Miller Lectureship*: Value Rs. 350. A course of not less than two lectures should be delivered on a subject dealing with the exposition of the Inner Meaning of Human History as disclosing the One Increasing Purpose that runs through the Ages, with special reference to Indian History or Indian Culture.

(7) *The Dr. Elizabeth Matthai Lectureship* : Value Rs. 300. A course of not less than three lectures should be delivered on a subject embodying the results of original investigation in some branch of Medicine and Surgery. Preference will be given to a subject having special reference to the requirements of women and children.

(8) *The Rt.-Hon'ble V. S. Srinivasa Sastri Lectureship* : Value Rs. 300. The lectures should be on a subject connected with the study of Political Science wth specal relation to India.

(9) *The Rt.-Hon'ble Sir George Stanley Lectureship* : Value Rs. 350. A course of three or more lectures should be delivered on any topic comprised in Æsthetics.

(10) *The Dr. Annie Besant Memorial Lectureship* : Value Rs. 300. The lectures should be on a subject connected with Politics or Civics or Sociology or Religion or Philosophy or Ethics or Education or Fine Arts.

For further particulars regarding the lectureships, please see University Calendar, Vol. I, Part I, 1945-46 (Appendix F).

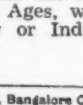
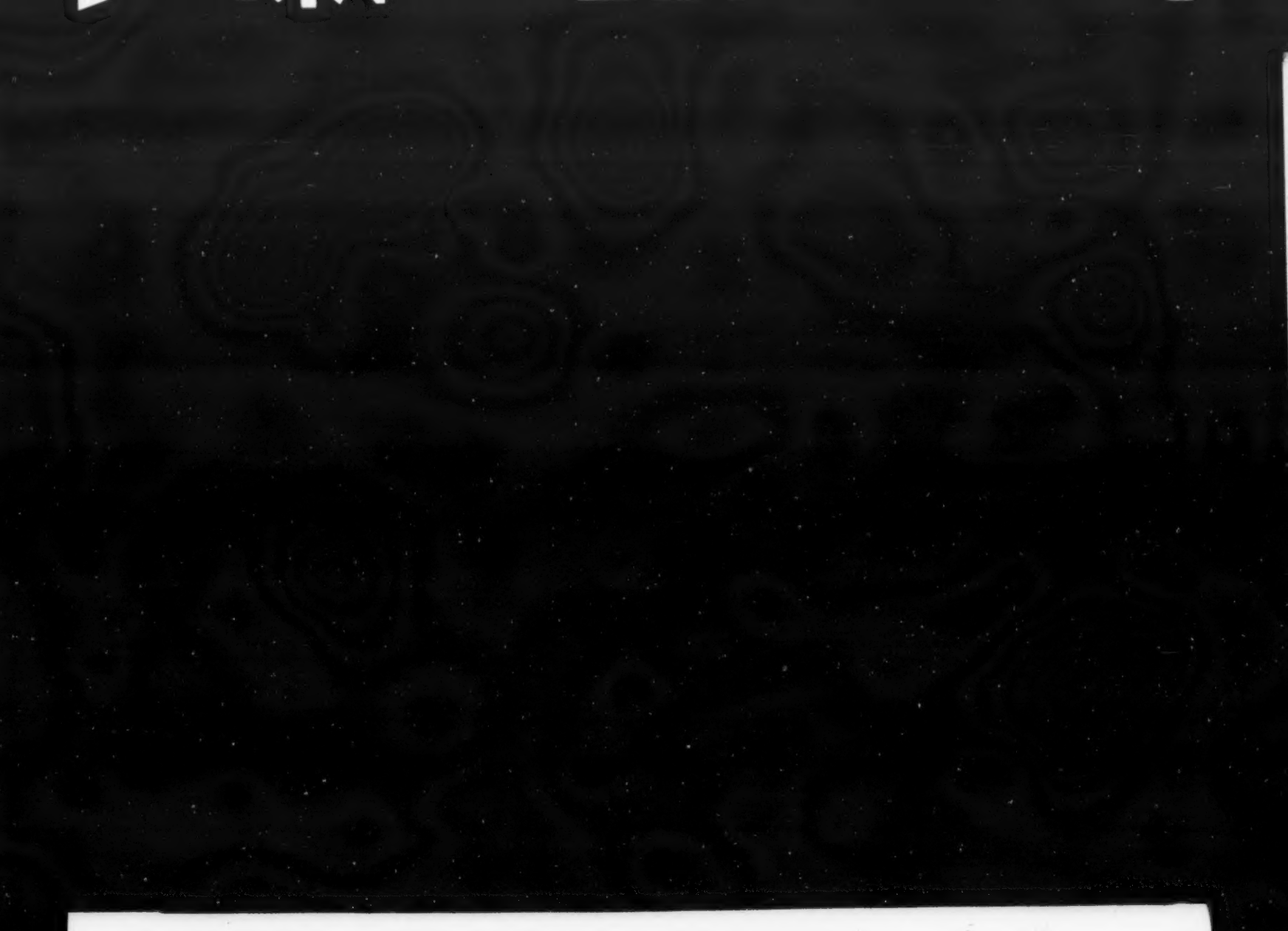
*National Institutes of Sciences of India*.—At the Annual General Meeting of the National Institute of Sciences of India held at Bangalore on the 1st January 1946, the following were duly elected Officers and Members of its Council for 1946 :—*President* : Mr. D. N. Wadia, New Delhi. *Vice-Presidents*: Sir S. S. Bhatnagar, Delhi; Prof. H. J. Bhabha, Bombay. *Treasurer*: Dr. B. C. Guha, New Delhi. *Foreign Secretary*: Sir J. C. Ghosh, Bangalore. *Secretaries* : Rai Bahadur S. L. Hora, Calcutta ; Prof. D. S. Kothari, Delhi. *Editor of Publications*: Dr. J. N. Mukherjee, New Delhi. *Members of Council* : Dr. Bashir Ahmad, New Delhi; Prof. K. N. Bahl, Lucknow; Dr. S. K. Banerj, New Delhi; Dr. Verrier Elwin, Patangarh, C.P.; Brigadier E. A. Glennie, Delhi ; Khan Bahadur M. Afzal Husain, New Delhi; Prof. M. O. P. Iyengar, Madras; Prof. K. S. Krishnan, Allahabad; Prof. P. C. Mahalanobis, Calcutta ; Dr. B. N. Prasad, Allahabad ; Dr. H. S. Pruthi, New Delhi; Prof. M. Qureshi, Hyderabad (Dn.); Dr. L. A. Ramdas, Poona ; Rai Bahadur J. M. Sen, Krishnagar; Professor M. R. Siddiqi, Hyderabad (Dn.); Lt.-Col. S. S. Sokhey, Bombay; Dr. A. C. Ukil, Calcutta.

## ERRATA

*Vol.* 15, *No.* 1, *January* 1946 :

Page 20, line 2, *for* pu *read* $\rho_v$ ; line 4, *for* $2\rho_c/1+\rho_v$). *read* $2\rho_v/(1+\rho_t)$ ; line 42, *for* Narayan *read* Narayanan.

Page 29, Review of the book "Selected Topics from Organic Chemistry", column 2, line 1, *for* help- *read* helpful. Between lines 17 and 18 the correct formulæ should *read* as follows:



188-46 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore